THE

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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THE LONDON COUNTY COUNCIL ELECTRIC SUPPLY BILL.

IN our comments upon the promotions of Bills and Provisional Orders—Session, 1902 (ELECTRICAL REVIEW, November 29th, 1901), we pointed out that the London County Council were making "a bold attempt to convert all the electric supply business of the County of London into municipal undertakings," and the Bill for constituting this gigantic monopoly has actually passed a second reading in the House of Commons, in spite of the opposition of the Board of Trade, and the votes against it of all the members of the Government who were present.

The majority in favour of the Bill was composed of a remarkable combination of the Socialist party, headed by Mr. Lough and Mr. John Burns, and a large number of supporters of the Government representing metropolitan and other constituencies.

Mr. John Burns explained that under the Bill the power sought was simply to do by a combination of Borough Councils what each could already do separately within its own area. He assured the House that the London County Council did not wish to be the electric lighting authority for the whole of London; but, if that be the case, it is hardly consistent with his own desire to see all trade municipalised; nor could the comprehensive scheme contemplated lead to any other result than a huge monopoly controlled by amateurs at the risk of the ratepayers.

The President of the Board of Trade pointed out the difficulty of carrying out the complicated scheme proposed, and practical men know that it is impossible.

In moving the second reading, Mr. Lough explained that purchase within the area of the London County Council, under the Acts of 1882 and 1888, was inoperative, because more than one company had powers to supply within the same district, and others had their generating stations outside any of the areas. Does Mr. Lough wish to alter these arrangements? Does he desire to put an end to that wholesome competition between companies, which proves how absolutely absurd it is to claim for municipalisation of electric lighting that it will destroy company monopolies?

Of course, there never has been, nor can be, any company monopoly, but in advocating municipal trading it has been the favourite argument that it is intended to prevent any more company monopolies, and yet here is a Bill being promoted ostensibly to put an end to company competition!

The Bill provides for the purchase of the generating stations of power companies, established *within* or *without* the County of London, which supply authorised undertakers only; a monstrous proposition, showing how little the business is understood or has been thought out.

The promoters of the Bill appear to have some glimmering perception of the change which is coming over the business of electrical supply by the adoption of long-distance trans-

mission of electrical energy, and the ultimate conversion of most of the present generating stations into transforming and distributing works only. They think, therefore, that they ought to possess power to buy up any power station, although established outside the charmed area constituting their own little borough; but it does not appear to have occurred to them that one such station may be supplying an area of 350 square miles, of which their district forms a very small part. Under such circumstances, the price to be paid for compulsory purchase, with due regard to severance, would astonish the enthusiastic Borough Councillor, who talks so glibly about the "provision for purchase of generating station of company supplying authorised undertakers."

The Bill is alleged to be the result of a conference between the London County Council, the City Corporation, and the local authorities, who unanimously agreed to the suggestions embodied in the Bill. We suggest that before Parliament becomes a party to any such scheme a referendum to the ratepayers would be desirable. There is no urgency in the matter, as none of the provisions of the Bill are to come into operation until the year 1931.

Everyone knows how apathetic the ratepayers are, and the small number that take any personal interest in the selection of their local authorities; but they are beginning to understand the question of municipal trading in electricity, and as the financial failures are published in the accounts of nearly every town which has undertaken it, other ratepayers pronounce against joining in the crusade for preventing private enterprise from exercising a legitimate business, and providing what is required without risk to the public purse.

The Bill of the London County Council deserved a fuller and more exhaustive discussion in the House, and it is most important that it should be thoroughly dealt with in Committee, for which purpose all the companies affected should confer at once, with a view to combined action.

Mr. Bryce suggested a reference to a Select Committee because of the impossibility of the House dealing with the Bill as it ought to, and we shall be much surprised if such a tribunal sanction any proposal of this nature.

The London County Council might study with advantage what is taking place in the East Middlesex district. Last year five contiguous Urban Districts combined to promote a Bill for a joint municipal supply of electricity for Tottenham, Edmonton, Enfield, Wood Green and Southgate, and the advocates of the scheme impressed upon the ratepayers the absolute necessity of such a comprehensive scheme for obtaining a supply upon cheap terms, but so opposed were the ratepayers to any speculation of the kind, that on polls under the Borough Funds Act the scheme was defeated by large majorities and abandoned.

Notwithstanding this decision—which was accepted by Enfield, and arrangements made for the supply of that town by a company—Tottenham, Edmonton and Wood Green are applying for provisional orders for isolated stations to supply their several districts, after having assured the ratepayers that such schemes were uneconomical. It is not to be wondered at that the ratepayers are up in arms, and have requisitioned the Urban District Councils to submit the matter to their constituents, but without success.

Meanwhile the North Metropolitan Electric Supply Company are endeavouring to meet the position by applying for power to distribute energy in the districts in question, and it is understood that the matter will be dealt with by a special Parliamentary Committee.

The approaching elections in the East Middlesex district are turning upon the question of municipal trading in electricity, and the results will be watched with interest, especially at Hendon, where the grant of the loan for carrying out the provisional order depends upon the result—the Local Government Board having postponed a decision until the elections are over. This is a step in the right direction, as it indicates on the part of the department a desire to respect the wishes of the ratepayers.

Electrical Legislation and the I.E.E.

WHAT has become of the committee appointed to deal with the question of electrical legislation? Mr. Madgen read his paper on "The Electrical Power Bills of 1900—before and after"—about 13 months ago, and more than a year since, a committee was appointed and evidence taken. Great dissatisfaction is said to exist at the delay in issuing any report of the proceedings of the committee.

The Second Automobile Exhibition in New York.—Some details of the exhibits at the above show may be interesting to electricians. The new Edison cell was exhibited, the cells shown being 30 cm. high, 5 cm. broad, and 12·5 cm. in length. They weighed 3·4 kgs., and were said to yield 120 watt-hours, or 1 E.H.P.-hour per 20·7 kgs. of weight. The Porter Battery Company, of Chicago, and the Hydra-Double Battery Company, of New York, each had exhibits of their special manufactures. The latter company make a half-dry element for ignition purposes. The Electric Vehicle Company showed a light electric car, or "Runabout," 394 kgs. only in weight, provided with a battery of 40 of the new "Exide" cells, capable of driving the vehicle 64 kms. at a speed of 22 kms. per hour. A larger carriage by the same firm weighed 754 kgs. The American Bicycle Company exhibited a business wagon, with two motors, and an 80-volt battery of the Sperry type of storage cell. A "Runabout," by the same company, weighed 450 kgs., and carried a 30-cell battery, with a discharge capacity of 125 ampere-hours. With this carriage a speed of 27 kms. per hour could be attained, with a current consumption of 28 amperes. The motor was of the six-pole D type, and three speeds could be obtained by the various methods of connecting up the battery to the motor windings. The Baker Motor Vehicle Company showed a light Stanhope carriage, weighing 405 kgs. The battery of 10 cells was built with Planté plates, and sufficed to drive the vehicle under normal road conditions, 64 kms., on one change. It weighed 140 kgs. The controller permitted three speeds to be obtained. The same firm exhibited three other electric carriages or "Runabouts."

The Peigne Accumulator Cell.—A new type of accumulator plate, called the "Peigne," was described in a recent issue of the *Centralblatt fur Accumulatoren und Elementenkunde*. The positive and negative plates consist of cast-lead strips, both faces of each strip being covered with right-angled corrugations. After pasting the strips are bound together into a composite plate, the width of the strip being the thickness of the finished plate. The pocket formation of the perforations prevents any falling out of the pasted mass, and the swelling of the lead composition, which occurs on charging and discharging, simply bends the strips, but does not cause the plate itself to buckle. These plates are made in two sizes. The smaller of these are intended for batteries of less than 240 ampere-hours capacity, while a larger form of plate is adopted for capacities above this limit. The accumulator plates are intended for use in stationary batteries, but a special design is being prepared for automobile purposes. The following are details of discharging tests with the smaller type of cell:—

Period of discharge in hours	3	5	10
Amperes	33	25	15
Volts	1·9	1·9	1·9
Watts	62·7	47·5	28·5
Capacity in ampere-hours	99	125	150
Energy in watt-hours	188	237	285
Weight of plates	28·86 kgs.		
Watt-hours per kg. of weight	6·5	8·2	9·8

The "Peigne" accumulators are made by the Société Electrique du Nord, and fuller details concerning them will be found in *Eclairage Electrique*, Vol. 29, p. 218. 1901.

ELECTRICAL SHOCKS AND THE FACTORY ACTS.

The discussion on the papers by Mr. A. P. Trotter, Major-General Webber and Mr. F. B. Aspinall was concluded on Thursday evening of last week at the Institution of Electrical Engineers and ranged round three subjects, each of which might have occupied the full time of the meeting. The medical men had a good deal to say respecting the action of the organs of the body and the effect of shock upon them; references were made to the legislation which has brought generating and transforming stations definitely within the scope of the Factory Acts, and something, but not much, was said regarding electrical shocks generally. In our last issue we dealt in part with the papers, and especially with the lessons to be learned from Mr. Trotter's demonstration of his invulnerability to a 500-volt battery. The discussion did not bring out any material point to alter our opinions then expressed, except, perhaps, that Mr. S. F. Walker explained how the Sheffield accident occurred, and showed that, in all probability, and in absence of medical testimony to the contrary, the victim was not shocked, but stunned to death by falling on a concrete floor. This, however, we allude to further in our "Notes" columns.

The arguments relating to the inclusion of electricity works in the dangerous trades may be taken as proving the desirability for reasonable supervision, although, as Mr. H. M. Sayers put it, the training of the average factory inspector does not necessarily render him the best judge of the precautions to be observed. Mr. Cunynghame made a point when he quoted the incident at the Committee on Railway Accidents, when a witness was asked whether, in his experience, he could quote one case in which the Factory Acts had been an obstacle to trade, and no reply was forthcoming. He admitted, however, that if not wisely administered, the Acts could be made a burden, but there was not on the part of the Home Office any such intention; all that was desired was the safety of the workman. Mr. Fearon, as an inspector of factories, regarded General Webber's opinion as being contrary to that of the industry generally, and said some hard things about companies, whose directors would often not take precautions if they meant the incurring of extra cost. Consulting engineers did not always pay sufficient attention to safety, and resident engineers found that their opinions did not carry sufficient weight with committees. Then the Home Office should step in and support the resident engineer in getting things made reasonably safe. The recommendations of the Home Office might be summarised under five heads:—

(*a*) Earth all dead metal.
(*b*) Protect all line metal.
(*c*) Do no work on high-tension metal.
(*d*) Safeguard men engaged near high-tension metal, and employ only skilled men.
(*e*) Learn the methods of artificial respiration, and use them when necessary.

We fail to see, however, how high-tension metal is to be protected. The most common high-tension board, that of Ferranti, Limited, cannot be made to comply with the recommendations of the Home Office. Yet it is reasonably safe if men of the proper type are engaged as switchboard attendants, and none other should be allowed on a switch platform.

Mr. H. Sayers urged the difference between a textile factory where women and children were employed and a central station. He also showed that in the latter a public service is rendered under penalty in the event of failure, and considered that safeguards might be proposed by factory inspectors which were likely to cause breakdowns. We believe that the real feeling in the industry lies midway between the two extremes. Engineers are anxious to render the employment in their works as safe as an occupation surrounded by high-pressure steam pipes and fittings, high-tension switch gear and apparatus, complex machinery, and the like, can be made; but they are not ready to submit quietly to outsiders who know little or nothing of the actual work of running and management prescribing what they are to do towards these ends, when as likely as not so-called safeguards may be traps to catch the unwary and place obstacles in the way of men doing their work properly, thus increasing rather than diminishing the attendant risk.

As might be expected, the medical gentlemen who spoke were down on Major-General Webber, and would have none of his heresy that the heart was not a pump. Drs. Hedley, Legge, Lewis Jones and Henry McCluer voiced the views of the profession, and in general accepted Mr. Aspinall's conclusions.

We will conclude by reprinting the tables given by Mr. Trotter of measurements taken upon those who submitted to the tests he suggested on the reading of the paper. Eighty persons submitted themselves, and 170 tests in all were taken. The results, finger to finger, were fairly consistent, but from foot to foot the influence of footgear seems to have had a very material bearing upon the resistances.

Foot to Hand.

Milliamperes taken.		No. of persons. At 100 volts.	At 500 volts.
0·0	...	—	14
1·0	...	1	5
1·5	...	2	—
2·0	...	1	4
2·8	...	1	—
3·0	...	2	1
4·0	...	2	4
5·0	...	2	—
5·5	...	1	—

Finger to Finger.

Milliamperes taken.			No. of persons at 100 volts.
1·0	...	...	1
1·5	...	...	9
2·0	...	...	10
2·5	...	...	7
3·0	...	...	5
3·5	...	...	1
4·0	...	...	3
4·5	...	...	1
6·0	...	...	2
8·0	...	...	1
10·0	...	...	2

Foot to Foot.

Milliamperes taken.			No. of persons at 500 volts.
0·0	...	...	17
0·25	...	...	1
0·5	...	...	5
1·0	...	...	2
1·5	...	...	1
1·75	...	...	1
2·0	...	...	5
2·5	...	...	1
3·0	...	...	3
4·0	...	...	1
5·0	...	...	2
8·0	...	...	1
11·0	...	...	1
14·0	...	...	1
15·0	...	...	1
17·5	...	...	1
20	...	...	2
24	...	...	1
25	...	...	1
28	...	...	1
30	...	...	1

ARMATURE INTERFERENCE AND BRUSH POSITION.

By H. M. HOBART.

(*Concluded from page* 451.)

It would be interesting, also, to have on a large 500-volt machine, with a very strong armature (as expressed in terms of the armature ampere-turns per pole-piece), curves analogous to those indicated in figs. 5, 6 and 7, and the results corresponding to the curves of each of the two latter figs. (6 and 7) should be obtained for each of several backward and forward positions of the brushes.

Some time ago, in a large central station, the writer made tests on a 10-pole slow-speed (90 revolutions per minute) 550-volt, 550-KW. generator, some of the results of which have a bearing on the questions raised in this article.

Tests of the excitation regulation were made with the brushes set successively in the neutral position, and with 4,

8, and 12 segments forward lead. The results which, although taken very roughly and hurriedly, yield fairly definite values for the excitation required to maintain 550

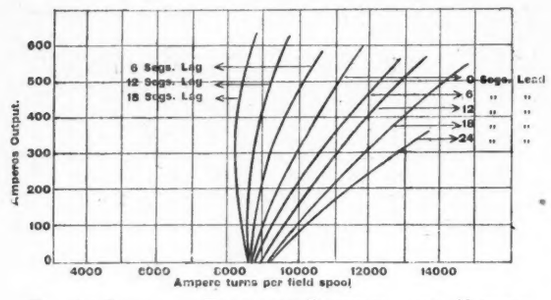


Fig. 5.—Curves of Excitation Regulation for Various Brush Positions.

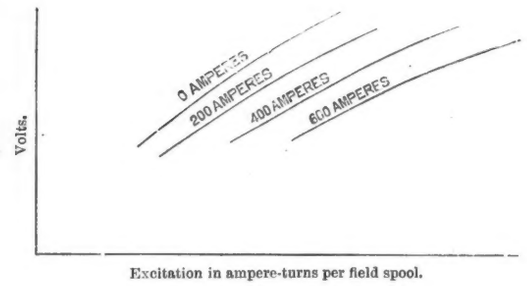


Fig. 6.—Saturation Curves.

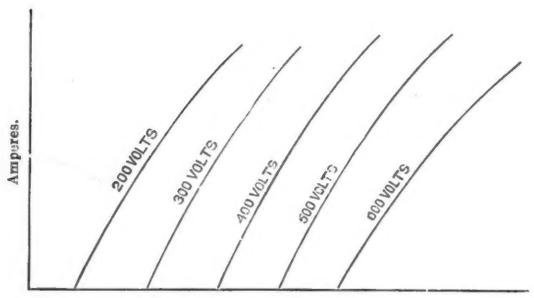


Fig. 7.—Curves of Excitation Regulation for Differ Voltages and Brush Positions.

volts at all loads up to one-half of full load (500 amperes), are set forth in Table IV.

Table IV.

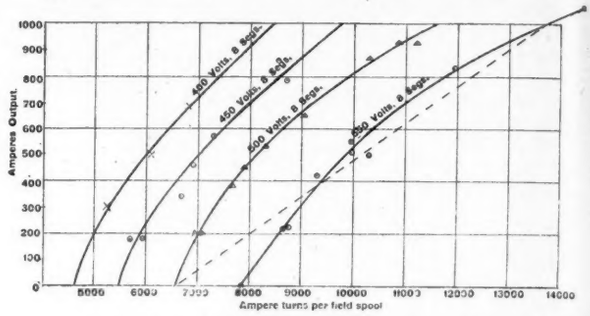
Segments lead of brushes.	Ampere-turns required for maintaining 550 terminal volts at no load, ¼ load, and ½ load.			Increase in excitation from no load up to ½ of full load, 550 terminal volts.
	No load.	¼	½	
0	7,900	8,350	9,200	16·5 per cent.
4	7,900	8,600	9,550	21·0 ,,
8	7,900	8,800	9,900	25·0 ,,
12	7,900	9,150	10,500	33·0 ,,

While these results are of interest, it should be understood that the machine was one constructed on the customary lines at present approved for railway generators, and hence not such a machine as one would construct for operation with backward lead. For that purpose, still lower reactance voltage and higher armature strength would be required, as well as a somewhat smaller pole arc and many other points of difference to which reference has already been made.

The following constants of the machine may be of interest;—

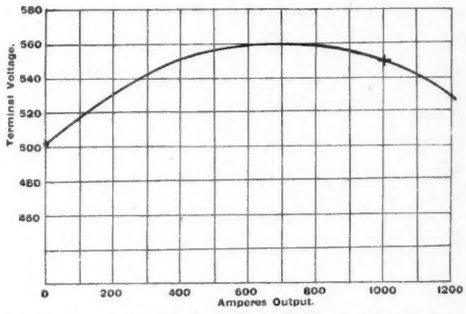
Armature ampere-turns per pole-piece at full load	= 9,000
Reactance voltage per segment at full load	= 3·9
Segments per pole-piece	= 90
Mean pole arc in per cent. of polar pitch...	= 62 per cent.
Standard brush position for all loads ...	= 8 segments lead.

Fig. 8 sets forth excitation regulation curves taken on this machine with eight segments brush lead at different voltages. As the machine was intended for over compounding from 500 volts at no load to 550 volts at 1,000 amperes output



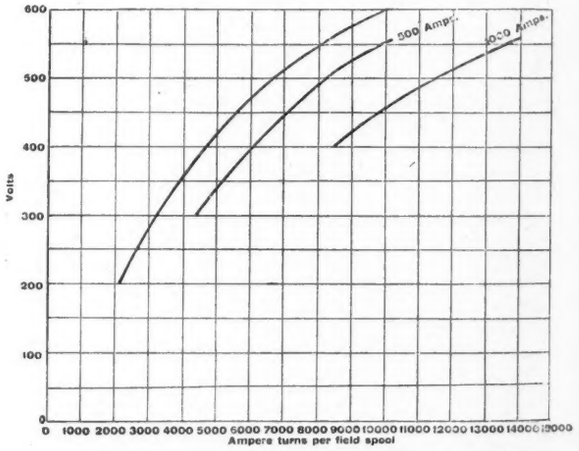
Speed, 90 r.p.m. Excitation regulation curves for various voltages, and 8 segments lead.

Fig. 8.—10-pole, 550-kw. Railway Generator.



Speed, 90 r.p.m. Inherent regulation curve when adjusted for 500 volts at no load, and 550 volts at 1,000 amperes output, 8 segments lead at all loads.

Fig. 9.—10-pole, 550-kw. Railway Generator.



Speed, 90 r.p.m. Saturation curves at no load, half load, and full load, 8 segments lead in all cases.

Fig. 10.—10-Pole, 550-kw. Railway Generator.

(full load), the inherent regulation curve for the machine with series winding and adjusted diverting shunt is derived by drawing a straight line as shown, from the intersection of the 500-volt excitation regulation curve with the axis of abscissæ, to the value of the 550-volt excitation regulation curve for 1,000 amperes (13,700 ampere-turns).

From this it is seen that the voltage automatically increases from 500 volts at no load to about 525 volts at 150 amperes, 550 volts at 400 amperes, 560 volts at 750 amperes, and then decreases to 550 volts at full load (1,000 amperes), and to lower values at overloads. This curve is given in fig. 9. In fig. 10 are given saturation curves at no load, 500 amperes and 1,000 amperes, and a brush lead of eight

segments. Such load saturation curves, although rarely taken, are very instructive.

It is very likely that projects for running dynamo-electric generators with the brushes in the neutral position, or even with backward lead, have been put forward in connection with machines having special features, such as pole-face windings, commutating coils, reversing lugs, or other special appliances, but, so far as the writer is aware, it has not been proposed to make this practicable with an ordinary design without special appliances, merely in virtue of the low reactance voltage and high armature strength employed in the design. This could not have been the case so long as the belief was held that the reversal of the current in the short-circuited coils should be accomplished by the customary electro-magnetic means. Also the prevailing belief that strong armatures were deleterious to good commutation, stood in the way of coming to this point of view.

ELECTRIC SHOCK AND LEGISLATION THEREON.

[By our Legal Contributor.]

This formed the subject of an interesting paper which was read by Major-General C. E. Webber, C.B., R.E., at the Institution of Electrical Engineers on February 27th.

The extraordinary development of electricity during recent years, and the increase which has taken place in the strength of the currents used, has very naturally turned attention to the necessity of guarding workmen employed in generating stations against risk of accident. Assuming that the "grandmotherly" policy which inspired the Factory Acts is calculated to serve the best interests of the workman and the public, it is but equitable that those Acts should be administered impartially in connection with every dangerous industry. In these circumstances Major-General Webber set himself to ascertain (*a*) what is the most modern opinion as to the nature of the injury which may be inflicted by an electric shock, with a view to ascertaining how the result of a shock can best be overcome; (*b*) the inquiries which led up to the inclusion of generating and transforming stations within the definition of the word "factory." He concludes his paper with a list of the rules which it is proposed to ask the factory inspectors to enforce in these places, and suggests that certain of these rules are open to criticism and discussion.

Electrical engineers cannot be expected to take an overweening interest in the actual physiological effect of an electric current upon the human frame. Nevertheless, there is one point made manifest by the reader of the paper which affects them very nearly, namely, that the consequences of a shock are often very similar to those which result from suffocation, and that artificial respiration, if promptly applied, may completely restore the sufferer. The researches which have led to this important discovery were carried out in France by M. D'Arsonval, and a set of rules for the guidance of those who can give first aid to the injured has been drawn up in that country. Such researches, alas! could never have been effectively carried out in England owing to the absurd restrictions which are placed on vivisection by a policy which surrogates human to animal life; nevertheless, the Electrical Review has for years past issued a set of rules, of which Mr. Aspinall spoke very highly in *his* paper.

To sum up the scientific portion of this subject, the author of the paper quotes from an article by Dr. A. M. Bleile, Professor of Physiology in the Ohio State University, on the cause of death in electric shock. This investigator killed the dogs upon which he operated with an alternating current having a periodicity of 130, at an E.M.F. of under 100 volts and under 1 ampere. The condition of the heart and arteries, as found by immediate autopsy, led him to the exclusion of a direct effect upon the heart. Dr. Bleile concludes by saying:—"It would appear, therefore, that death in electric shocks is entirely due to the fact that the current produced a contraction of the arteries through an influence on the nervous system, and that this construction throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome."

One melancholy interest attaches to death by electric shock, namely, that it is the most merciful way of terminating human existence. This statement is founded upon certain investigations made in the United States. In the case of People *v.* Durston (119 N.Y. 569) the question as to whether execution by electricity is legal or no was raised on behalf of a prisoner sentenced to death. The argument as to the illegality of the method was based upon a clause in the American constitution which forbids cruel and unusual punishments. In the course of a judgment which declared this kind of execution to be legal, the Appeal Court in New York shows that the introduction of electrocution in New York State was the result of a thorough investigation by a commission into the most humane form of inflicting the death penalty. The statute provides that: "The punishment of death must, in every case, be inflicted by causing to pass through the body of the convict a current of electricity of sufficient intensity to cause death, and the application of the current must be continued until the convict be dead."

The more practical, and, to electrical engineers, the most interesting part of the author's paper, is that which relates to the inclusion of electrical generating and transforming stations in the Factory Act, 1901. It has for some time been a matter of dispute whether, apart from the recent Factory Act, a generating station came within the definition of the term "factory," on the ground that the generation of electricity on a large scale was the manufacture of an article of commerce by way of trade, and for purpose of gain. The view that factory inspectors were entitled to exercise their jurisdiction over electrical works was accepted by the proprietors of many stations, and was laid down as a proposition of law by a magistrate in 1899. The discussion of the point has now, however, become purely academic, in view of the following paragraph which was inserted in the list of non-textile factories which are affected by the Factory and Workshop Act, 1901:—

"Electrical stations," that is to say, "any premises, or that part of any premises in which electrical energy is generated or transformed for the purpose of supply by way of trade, or for the lighting of any street, public place, or public building, or of any hotel, or of any railway, mine, or other industrial undertaking."

Rules have already been framed which we presume are in due course to become statutory rules and orders under the Factory and Workshop Act, 1901. Framed under the auspices of the Dangerous Trades Committee, they contain (*inter alia*) the following provisions, upon which Major-General Webber invited discussion at the Institution:—

3. All terminals, collecting brushes, main connectors, parts of dynamos, motors, or other appliances, to which neither Regulation No. (6) nor No. (7) applies, shall be so placed, covered, or fenced with non-conducting materials, that no person can touch accidentally, either with his body, clothing, or any conducting tool, two parts differing from each other by an amount which constitutes a high pressure.

6. In switch rooms and on the front of switchboards, the main switches, main fuses, main terminals, omnibus bars, and all other metallic parts, shall be insulated or arranged in such manner as to render it impossible for any person by accident or inadvertence to touch them.

7. The backs of all switchboards shall be kept closed, except for the purpose of alterations or repairs. When such work has to be carried on either at the back or at the front of switchboards, the following regulations shall apply:—

(*a*) No person, except a skilled electrician, or a workman under his personal and immediate supervision, shall be employed when any part is at high pressure.

(*b*) No extensive or serious repairs shall be executed upon metal which is at high pressure.

(*c*) Where the alterations or repairs are not of an extensive or serious character, all metallic parts at high pressure shall be covered with an insulating cap, or protected by some form of insulating covering, only one part, or several at the same pressure, to be exposed at any one time.

With regard to this rule it is asked, What constitutes a skilled electrician? If he takes a workman with him behind a switchboard, is he to be responsible for the results of the man's possible carelessness?

13. Where operations are being conducted upon mains from which the current has been cut off the switch shall be locked, and precautions taken that it shall not be unlocked except by the person in charge of the station on his being satisfied that the danger is at an end.

15. Metal transformer boxes shall be efficiently connected to earth, and so constructed that in the event of "running to frame"

the earth connection will not be broken by the removal of the fuse box or any other part of the box.

17. All holes in transformer cases through which high pressure conductors pass shall be lined or bushed with suitable and effective non-conducting material.

18. All high pressure connections within a transformer chamber shall be so protected with insulating material that it shall be impossible to touch them.

19. Switches which can be conveniently operated from the outside for cutting off both the high and the low pressure connections of the transformers shall be fitted in all transformer chambers erected after the application of these rules, and in all existing chambers, unless it is proved to the satisfaction of his Majesty's chief inspector of factories that such an arrangement would be attended by special difficulty.

20. Each post or support where series arc lighting is employed shall be provided with means for completely disconnecting the arc lamps from the mains without disturbing the action of the other lamps.

As to the above rules, the author of the paper points out that they refer to parts of a system of distribution that has nothing to do with generation and manufacture, except in so far as lies in the contention that transformation is to be regarded as part of the process of making electricity for purposes of sale.

The rules are somewhat lengthy and appear to enter into considerable detail. In our view (and we think it is shared by the author of the paper) they place too great a burden upon the proprietors of a generating station. In framing them sight seems to have been lost of the fact that the electrical industry is essentially one for the employment of grown men; those lengthy provisions of the Act of 1901 which regulate the hours and method of employment of women and children are practically useless in relation to the generation and supply of electricity. Further, if minute inspection and strict enforcement of the proposed rules is a work of supererogation in generating stations, it passes comprehension to hear that transforming stations are also to be subjected to inspection.

In conclusion, we trust that the author's paper, the discussion thereon, and the "sense" of the Institution upon the matters under discussion, may induce the Home Office to refrain from placing undue and unnecessary restriction upon the electrical industry.

THE INFLUENCE OF TARIFFS ON ELECTRICITY SUPPLY.

By C. ASHMORE BAKER.

It is of particular interest at the present moment—the subject of tariffs having been recently brought into prominent notice by Mr. Wright and others—to ascertain if possible the influence which the various methods of charging for electrical energy may exert on the load factors and financial results of electrical undertakings.

There are many difficulties in the way of making an equitable comparison between the working results of a few selected concerns, and, moreover, comparisons by such methods would be apt to be rendered misleading and inconclusive by local disturbing influences.

A means is nevertheless available, which, although of only approximate accuracy, may be accepted as sufficiently veridical to serve as a guide to the general tendency which any particular influence may exert, and which may be thus stated :—

If a number of quantities of comparable but varying value be classified according to the presence or absence of any particular factor, the difference in the average values of the two classes will indicate the general influence of that factor.

To take a case in point: suppose the population of a given district be classified as vaccinated and unvaccinated, and it is found that the percentage contracting smallpox is greater in the latter class than in the former, it would be reasonable to attribute to vaccination an influence favourable to the prevention of smallpox.

In the case of electric light and power undertakings, it is scarcely practicable to examine the results obtained by the whole of the concerns in the country, nor is such a proceeding necessary, provided a sufficient number of cases be selected for examination, and that such selection be made fortuitously as regards the factors whose influence it is desired to ascertain. With this end in view the writer has taken for examination all those undertakings included in the *Electrical Times* list of January 9th, merely eliminating those (17 in number)

TABLE I.

	Maximum load.	Load factor.	Year's Lamp increase per cent.	Price. Cost.
Companies, London. Private Lighting Only.				
Flat Rate.—				
Kensington	2,350	12·78	8·5	1·78
Brompton	1,307	13·05	14·4	2·32
Woolwich	407	7·11	102	1·87
Mean		10·98	41·6	1·99
Maximum Demand.—				
Clerkenwell	1,826	12·36	54·4	1·47
Chelsea	1,809	10·55	12·7	2·04
Wandsworth	1,453	7·96	65·4	1·55
Mean		10·29	44·16	1·68
Sliding Scale.—				
Notting Hill	640	13·95	14·5	1·855
Private and Public Lighting.				
Flat Rate.—				
Metropolitan	8,904	12·63	14	1·56
Charing Cross... ...	3,049	18·71	21·5	1·76
Mean		15·67	17·7	1·66
Maximum Demand.—None.				
Sliding Scale.—				
City	11,230	12·68	21	1·35
Westminster	6,030	13·78	11·4	2·09
St. James's	3,624	16·15	13·1	2·22
Mean		14·2	15·16	1·886
Companies, Provincial. Private Lighting Only.				
Flat Rate.—				
Norwich	1,170	11·55	20·4	1·57
Altrincham	380	10·65	—	1·004
Guildford	110	8·64	37·5	·925
Mean		10·28	28·95	1·166
Maximum Demand.—				
Bournemouth... ...	824	9·35	21·1	1·92
Hove	605	10·17	17·9	1·99
Northampton... ...	401	7·15	28·7	1·52
Bromley	223	10·72	54	1·7
Winchester	153	8·45	51·2	2·01
Salisbury	138	9·3	55·9	2·42
Harrow	120	10·8	36·5	1·66
Newmarket	106	5·05	—	1·51
Oswestry	63	7·73	2	1·5
Alderley	26	6·3	—	·622
Mean		8·502	33·4	1·685
Sliding Scale.—				
Reading	445	8·68	22·8	1·86
Public and Private Lighting.				
Flat Rate.—				
Newcastle District ...	1,036	12·79	16·4	1·87
Oxford	468	11·8	11	1·83
Cambridge	436	9·36	10·15	2·16
Richmond	285	8·72	26·7	2·04
Liverpool	173	6·79	41·5	1·26
Pontypool	111	7·03	14·55	2·02
Mean		9·415	20·05	1·86
Maximum Demand.—				
Newcastle-on-Tyne ...	1,163	10·75	16·4	1·8
Preston	861	10·72	26·2	2·22
Folkstone	323	13·49	35·6	1·6
Wycombe	268	9·93	121·5	1·79
Northwich	126	8·04	47·2	1·855
Isle of Wight ...	110	11·12	—	1·78
Prescot	94	12·72	30·8	1·54
Mean		10·97	46·3	1·797
Sliding Scale.—				
Scarborough	382	9·61	22·6	1·76
Windsor	312	12·22	28·2	2·13
Mean		10·915	25·4	1·945

TABLE I.—(*continued*).

LOCAL AUTHORITIES, LONDON.

PRIVATE LIGHTING ONLY. ... ... NONE.

PUBLIC AND PRIVATE LIGHTING.

FLAT RATE.—None.

MAXIMUM DEMAND.—

St. Pancras	2,275	15·09	28·3		1·66
Hampstead	1,506	13·33	20·1		1·56
Islington	1,386	15·31	29·3		1·82
Shoreditch	1,050	17·72	127		1·43
Hammersmith ...	1,008	13·62	45·5		1·78
Southwark	389	13·89	—		1·52
Mean		14·83	50·04		1·63

SLIDING SCALE.—None.

LOCAL AUTHORITIES, PROVINCIAL.

PRIVATE LIGHTING ONLY.

FLAT RATE.—

Leeds	2,550	11·28	24·5		3·07
Sheffield	1,800	12·08	31·4		2·5
Leicester	1,095	8·38	35·9		1·87
Mean		10·58	30·6		2·48

MAXIMUM DEMAND.—

Hull	1,633	9·14	34·6		1·72
Walsall	301	10·45	30·3		1·56
Burton...	244	8·86	29·9		2·16
Colchester	162	7·85	—		1·66
Hereford	112	8·77	—		2·46
Leigh...	86	10·22	—		2·07
Mean		9·215	31·6		1·938

SLIDING SCALE.—

Birmingham	2,700	12·86	24·7		1·88

PUBLIC AND PRIVATE LIGHTING.

FLAT RATE.—

Edinburgh	5,480	13·97	27·7		2·15
Bradford	2,742	14·26	30·1		2·49
Portsmouth	1,506	12·01	11·33		1·78
Huddersfield	1,012	10·72	29·6		2·37
Dundee	746	9·46	36·5		1·98
Chester	603	14·78	14·7		2·38
Bedford	550	13·61	19·8		1·58
Newport	506	10·58	26·5		2·37
Bath	493	11·24	40·4		1·82
Burnley	387	10·21	11·5		2·19
Yarmouth	382	10·66	20·2		1·5
Lancaster	366	10·13	12·6		2·04
Leith	356	16·41	72·4		1·72
Ayr	282	19·85	12·05		2·44
Wakefield	244	10·75	18·65		2·34
King's Lynn	180	15·54	—		2·06
Stafford	171	13·37	26·4		1·285
Nelson	119	10·19	24·5		1·65
Redditch	114	13·18	—		1·18
Morley	84	10·57	18·6		1·08
Mean		12·57	25·2		1·92

MAXIMUM DEMAND.—

Glasgow	6,308	12·33	52·5		1·64
Brighton	2,968	14·33	21·8		1·82
Belfast	1,308	7·92	52·5		2·01
West Ham	963	10·84	—		1·375
Croydon	922	13·3	31·3		2·17
Cardiff	729	10·78	37·7		1·76
South Shields... ...	705	12·24	34·6		2·38
Salford	700	11·68	—		·945
Wolverhampton ...	642	11·26	34·2		1·73
Derby	610	11·01	25·1		1·99
Hanley	634	11·58	18·3		1·59
Cheltenham	560	13·32	23·6		1·87
Harrogate	470	13·29	32·6		1·72
Leyton	469	14·81	40·8		1·38
Eastbourne	424	12·04	—		1·9
Tunbridge Wells ...	423	13·40	18·7		2
Wimbledon	367	20·04	—		2·56
Coventry	330	11·82	32·6		1·49
Taunton	320	10·96	43·1		2·18
Kingston	320	11·02	17·2		1·19
Llandudno	316	8·72	37·9		2·70
Lincoln	286	8·99	33·4		1·51
Barnsley	245	9·32	—		2·52
Dewsbury	235	11·31	25·9		1·54
Canterbury	233	10·64	43·4		2·25
Bury	224	13·31	26		1·74
Stockport	222	12·46	54		1·80
Barrow	219	10·99	46·6		1·32
Greenock	210	8·57	—		1·775
Shrewsbury	136	9·69	—		1·72
Eccles	120	13·72	8·9		·933
Mean		11·79	33·0		1·797

TABLE I.—(*continued*).

SLIDING SCALE.—

Manchester	6,876	12·94	39·3		1·72
Bristol	2,099	11·92	31·3		1·52
Dublin	675	9·82	11·1		1·285
Hastings	495	12·16	22·7		1·47
Ealing	472	14·55	21		2·25
Wallasey	300	10·25	49·4		2·3
Exeter	280	11·33	—		2·07
Mean		11·85	29·13		1·802

TABLE II.

SUMMARY OF TABLE I.

	Load factor.	Year's lamp increase %.	Price. Cost.
Flat Rate	11·75	26	1·88
Maximum demand ...	11·14	38·68	1·768
Sliding scale	12·19	23·79	1·852

providing a traction or other special supply. The remaining 115 being arranged and classified for reasons which will appear later as in Table I.

The systems of charging in vogue among the undertakings examined have been classified as :—

Flat Rate.—Comprising those in which a single price per unit is charged for lighting or a discount is given not based on the load factor value of the consumer.

Sliding Scale. — Including the Hopkinson system and discounts based upon the number of units consumed per lamp wired, &c.

Maximum Demand, and analogous systems.

(*To be concluded.*)

TUNBRIDGE WELLS TELEPHONES.

ACTING on the advice and estimates of an engineer who is well known as an advocate of competitive telephony, the Tunbridge Wells Corporation started an exchange system, obtaining a loan of £10,000 for the purpose. The system became such a "phenomenal success," that a new loan of £15,000 had to be asked for, and before the inquiry could be instituted £9,000 of it had to be spent. The situation, therefore, is that at the time of the inquiry £10,000 had been authorised, £19,000 had been spent, and, assuming the loan to be granted, £6,000 will be available for the immediate future. If the "phenomenal success" continues—and we see no reason why it should not—further loans will certainly be required.

In connection with the inquiry statements were prepared (p. 402 of our issue of 7th inst.) which, though really estimates, apparently conveyed the impression that they represented actual results. These statements showed that the enterprise was on a paying basis, and it was the purpose of the opponents to demonstrate the contrary. Most of the items of expenditure were attacked as ridiculously inadequate or based on too sanguine estimates, but the crux of the question was recognised as being the estimated income and the lack of any allowance for depreciation. The income was estimated in this way :—A certain number of lines have been in use for varying periods ; the income accrued was turned into an annual average per line. For the expenditure represented by the total loans a certain number of completed lines would be obtained. Multiplying the completed lines by the ascertained average earnings of the existing used lines gave a certain figure. The opponents called evidence to show that it would be impossible to employ all the constructed lines for revenue purposes, and that, therefore, the estimated revenue must be appreciably reduced. They also showed that depreciation must be reckoned with. The reduction of the income on the one side, and the allowance for depreciation on the other side, turned the apparent profit into an obvious loss.

The National Telephone Company have an exchange in the town. The advantage to that company of the cessation of the competition is so clear that no surprise need be felt that the advocates of the municipal enterprise regarded the opponents as simply "playing the game" of the National Company.

To us it would seem that the question for the people of

Tunbridge Wells to consider is not what somebody else is going to gain or lose by the cessation of competition, but what they are themselves going to gain or lose by its continuance. They may conclude that it is to the advantage of their community to carry on their enterprise at a direct loss in consideration of indirect benefits obtained. They may very reasonably conclude that it is altogether too early to consider the question of profit, and that the more or less distant future will well repay any expenditure over income that may now, or in the immediate future, be called for. But whatever the situation may be it should be frankly stated and fairly faced.

We turn now from the question as immediately affecting Tunbridge Wells, and consider it as regards municipal telephony in general. In the course of an able speech the Town Clerk said that they were asking one department of the Government for the means to carry out a duty placed on them by another Government department. If the loan were refused, the sooner the Telegraph Act (1899) was repealed the better. We consider the remark a perfectly permissible one; but we think it well to point out that it is an over-statement. The Government did not impose a duty. They only gave a facility. It is not the duty of a municipality to enter upon telephone business. It *is* the duty of a municipality to take care that the interests of the ratepayers are safeguarded, and that any enterprise is entered upon on impartial and unprejudiced advice. It is the duty of a municipality to take care that an engineering question is dealt with in a sound engineering way, and that a financial question should be handled, not with the greatest optimism, but rather with the greatest pessimism. To disregard depreciation in a developing business is simply to draw a bill on the future. The wheels are being worn by the present users, and the present users should pay for the wear. If they do not, they are receiving service below cost, and the attempt by any responsible official or member of a municipality to justify such unsound measures can only result in lowering the standard of municipal securities generally.

We have said that the Government in the Telegraph Act of 1899 did not impose a duty, but simply gave a facility. Nevertheless, we have some sympathy with Mr. Cripps in his contention that encouragement was offered. It was very properly shown by Mr. Robb that in their own venture the Government had adopted a different policy.

It is open to the provincial centres to draw their own conclusions from the Government methods in London. If they prefer to be influenced by specious arguments there will be a serious reckoning, and theirs is the responsibility. But it is questionable whether the Government should not be called upon to reconsider or re-affirm the policy represented by the Act of 1899. If the Government deliberately determine to leave the telephoning of the provinces to the local bodies, then the time is near at hand when the municipalities will have to take up the question in a sober and serious spirit, under responsible expert advice and suitable Government supervision.

Tunbridge Wells is encouraged to incur a debt of £25,000 with the comforting assurance that Glasgow, for the same purpose, is incurring a debt approaching ten times as much, both with the same technical adviser, and both undeniably under the impression that they are advancing the welfare of their communities, and promoting the interests of applied science. They have embarked in the undertakings, and—whether men of Kent or men of Clyde, it matters not—having embarked, they will not readily turn back. It was urged before the Inspector at Tunbridge Wells that the refusal of the loan would mean the sacrifice of the amount already spent. We cannot admit the accuracy of the contention, but if it were true, the retort of Mr. Thorn Drury is very applicable. He characterised the suggestion as the gambler's argument. We doubt if the gambler's argument of the necessity of further tempting the fates is really so important as the element of local patriotism to the people concerned.

To abandon the enterprise would be regarded as a severe blow to the prestige of those who started it, and since it can be maintained by the simple expedient of raising further loans, which the ratepayers of the future will have to defray, we see no reason to anticipate any immediate cessation of hostilities in those localities where opposition has already commenced. It is but fair to those localities to remember that their opposition preceded the arrangement entered into by the Government as regards their own Exchange in London. Those municipalities which may hereafter embark on telephone enterprises, are differently situated. We consider that they will be in a position of grave responsibility if they undertake the work on such foundations as were brought to light in the course of the Local Government Board inquiry at Tunbridge Wells.

CORRESPONDENCE.

500-Volt Shocks and Rail v. Road.

The largest current taken by Mr. Trotter in his demonstration was 35 milliamperes, so that even if his battery had, as you state, 500 ohms internal resistance, he must have had about 480 volts terminal D.P. It is surely rather hair-splitting to maintain that 4 per cent. difference renders the demonstration valueless.

In your "Electromobile Notes" there is a paragraph which, taken as it stands, appears to mean that railway motors have only half the efficiency of electromobile motors. As, however, the comparison is between trains running half-mile sections—so that by far the greater part of the energy is for acceleration—and motor cars running perhaps 50 miles without a stop, its value is not very obvious.

Taking your figures of 12 and 50 lbs. per ton for haulage as correct, and assuming motors of 85 per cent. efficiency, the energy consumption for haulage at steady speed is obviously as follows:—

Railway train	...	28	watt-hours per ton-mile.
Motor car	...	116	„ „

On short sections of line like those on the Central London, the energy consumption per ton-mile for a given schedule speed varies practically inversely as the square root of the length of the section, so that the absurdity of the comparison which it is attempted to make is sufficiently obvious.

William Casson.

London, *March 14th*, 1902.

[The comment upon shocks, from the pen of Mr. Casson, is wholly beside the point. We did not state that Mr. Trotter's battery had an internal resistance of 500 ohms; these figures referred to good-sized Leclanché's. But what we do contend, and most strenuously so, is that a battery demonstration of this nature has no value; in fact, it might easily lead to lamentable results if those ignorant of the difference between a testing battery of 500 volts and a generator of the same pressure, should attempt to emulate Mr. Trotter's performances.

It does not concern us that Mr. Trotter's largest current was only 35 milliamperes; but we have a duty to perform in warning the reckless, the unwary, or the ignorant, against the current that kills.

Some 10 years ago the writer of a series of articles in the Review, entitled "The Current that Kills," said: "With the continuous current we find from medical sources that very rarely is a current of more than 200 to 250 milliamperes administered direct to the body, and then only for *destructive* purposes, the current being *carefully localised*, vital organs avoided, and the patient placed *under an anæsthetic*. There have been cases on record where the current has been run up to 500 milliamperes, but there seems to be great hesitation on the part of the profession to pass such a current, even for the strictly localised destructive action referred to above. Mr. Perry and others have concluded that 1 ampere is always a fatal current. . . . . It is manifest that the fatal point lies somewhere close to the maximum allowed in medical work, for, of course, when desirous of reducing abnormal growths such as tumours, &c., by means of the destructive action of electricity, the greatest current compatible with safety is used. Half an ampere, therefore, seems to us nearer the mark than an ampere, and probably represents the fatal point with sufficient closeness for the present." Further, the author does

not intend it to be understood that half an ampere would be fatal to everybody, nor, on the other hand, that a less quantity may not be fatal to some.

Dr. Lewis Jones stated on page 769 of the ELECTRICAL REVIEW for June 30th, 1893, that "it may still be accepted that the effect produced by the passage of a current through living tissues depends primarily upon the magnitude of the current as measured in amperes, which is made to traverse them, and upon its density or concentration therein."

Now, Mr. Trotter could not very well receive a deadly shock from such a battery as he used, even if the skin resistance came down to 1,000 ohms, because with the added internal resistance the current passing would fall short of the dreaded ½ ampere, but the case would be very different with a 500-volt dynamo, and this difference between Mr. Trotter's demonstrations and what may occur in everyday work is what we endeavoured to point out, perhaps less clearly than we should have done.

That Mr. Trotter should disclaim having anything to do with any conditions under which the resistance is less than 13,000 ohms—see page 4 of his paper—or, for hand-to-hand resistance, less than 30,000 ohms, seems to make matters worse. Is a man usually expected to fall on his finger tips, or skate, as it were, on the edges of his soles, when stepping on the metals in "tube" or other railways?

The values for resistance of the human body given in medical works, says Mr. Trotter, are of little use for the present purpose, for care is taken as a rule to facilitate the passage of the current; what, then, are we to think of experiments with currents, the greatest of which is not much more than a tenth of what is sometimes used in medical practice for curative purposes? Mr. Trotter's conditions are all abnormal, and therefore do not represent stern reality, but a letter which we publish from Mr. Neale may possibly have some practical bearing on the subject at issue, as also must Mr. Field's written contribution to the discussion.

Our correspondent has evidently not read the Notes, "Rail *v.* Road," in our last issue, very carefully. There is no such comparison between railway motors and electromobile motors as he assumes. Motor cars running on common roads do not run 50 miles without a stop; when passing through towns and villages they are stopping for traffic every minute, and a run of 10 miles even in the open country is unusual, probably the stops are as frequent as on the electric railways. The figures he gives would still show about the same difference as given in our Notes. The current actually used on the Central Railway is over 48 watt-hours per ton-mile, and the 28 watt-hours per ton-mile he gives would only show an efficiency of 58·3 per cent.; the difference of 41·7 per cent. must be accounted for by loss in conductors, transformers, and motor-generators, &c. The latter part of our correspondent's letter, whatever it may mean, is answered in our Notes, where equal speeds of the two systems only are compared.—EDS. ELEC. REV.]

500-Volt Electric Shocks.

In September, 1900, I was working at the C. & S. L. Railway generating station, Stockwell, and while adjusting the "generator" brushes (which were sparking badly) of one of the motor-generators, my foot came in contact with one of the tying-down bolts, causing a dead short on the generator, and burning both my hands so badly that I was unable to use them for over two months; it was six months before I had complete use of them. I was standing on a wooden platform and had got "dry boots" on, only having changed them about 15 minutes before the accident. The company had got rubber mats to each machine, but we only used them at the high tension, not thinking they were required at the low tension end. If Mr. Trotter doubts what I say, I would refer him to the Home Office.

I might say that it was over *four hours* before I was able to go home, though everything was done for me by the electrician-in-charge.

Geo. Neale.

Wimbledon, *March 15th*, 1902.

The writer of the article in the ELECTRICAL REVIEW on "500-Volt Shocks" has evidently overlooked the fact that Mr. Trotter, to prove that the current furnished by the batteries "*was not a laboratory one*," lit up for some time a number of lamps in series, arranged on a board to form the letters I.E.E.

As these glow lamps would take a considerable current, I think that the writer's arguments about the "laboratory" nature of the experiments are nullified.

Mortimer A. Codd.

Harrow, *March 18th*, 1902.

[See letter below for current.—EDS. ELEC. REV.]

You suggest that my experiments are unworthy of serious thought, as they cannot be considered the equivalent of what occurs in electric traction working with 500 volts where the generator has no internal resistance to take into consideration.

The largest current which I care to take is about 14 milliamperes, hand to hand. The resistance under those conditions, at 500 volts, must be 500,000 ÷ 14 = 35,714 ohms, and if the current be taken from a large dynamo, the whole of this resistance is in the skin and body. But if the current be taken from a battery having an internal resistance of 5,952 ohms, the total resistance will be 41,666 ohms, and the current will be reduced to 12 milliamperes (= 500,000 ÷ 12). The difference in sensation would be hardly perceptible.

But everybody who was present when my paper was read saw that during most of the experiments five lamps in series were burning brightly. These took about $\frac{1}{10}$th of an ampere. Before and after the experiments a bank of 25 lamps of 5-C.P. each, five in series and five in parallel, was turned on for a few seconds, and these lamps were brightly lighted. While I was sitting on the rails, the voltmeter showed 496 volts. The battery was, therefore, amply sufficient for the purpose.

I will not enter into a discussion on questions of opinion, but I quote one sentence from the conclusion of my paper:—"The conditions under which serious shocks *are not produced* by 500 volts are discussed in the paper, and it is safe to assume that all shocks more serious than those which are recorded, are dangerous."

Alex. P. Trotter.

8, Richmond Terrace, Whitehall.
March 17th, 1902.

Electrical Power Schemes: A Comparison of Two Recent Papers.

Pressure of work has prevented my making one or two observations on the interesting letter of Mr. P. M. Bennett in your issue of February 28th, and correcting what appears to be a slight inaccuracy—viz., that the prices of cables quoted by Mr. Bennett were for two cables. The figures given in fig. 4 of my paper are certainly for *two* line cables, but it is evident that Mr. Bennett has taken his figures from fig. 3, which relate to *one* line cable and makes a considerable difference in the costs. The results were that 15,000 volts was the most economical voltage for a cable transmitting 1,000 KW., 10,000 to 12,000 volts for a cable transmitting 600 KW., and 7,000 volts for a cable transmitting 300 KW.

Mr. Bennett has fallen into the very common error of assuming that my load factor of 38 per cent. was the load factor of the generating station. That is not so; the paper dealt only with the line and sub-station, the load factor being that of *a* particular sub-station. It is evident that the load factor of the numerous sub-stations must vary within wide limits; some may have an 8 per cent. load factor, others might attain 50 per cent., depending upon the nature of the consumers' demands within the area supplied by this sub-station. I arrived at 38 per cent. by taking a group of four large works within the area of supply of one of the power schemes, and after numerous observations on the working conditions, concluded that if these works were driven electrically and supplied from one sub-station, the load factor on the sub-station would be over 40 per cent. I reduced this to 38 per cent., as it represented a rough mean between that and a tramway load factor of 35 per cent., thus without impairing the value of the results obtaining figures applicable over a wider range.

In support of my figures, I may cite the case of the only power scheme yet in operation supplying through sub-

stations. The load factor on the *main generating station* is over 40 per cent., but as some of the sub-stations supply practically a city lighting load, their load factor may be in the region of 10 per cent. It therefore follows that some of the other sub-stations must have a load factor in the region of 50 per cent., which is likely, where the supply is to engineering and shipbuilding works running a double shift.

It will be seen, therefore, that my figure of 38 per cent. is not unreasonable, while I could hardly be considered loyal to the interests which I represent were I to take the least favourable load factor.

While on the question of load factors, the following figures, taken at random from my card index, may prove interesting:—

A Lancashire cotton mill	29 per cent. load factor.
An engineering works single shift	28 „ „
„ „ double „	42 „ „
Another „ „ „ „	35·5 „ „
A jobbing printer	15 „ „

The cotton mill had a mean load which was 90 per cent. of the maximum, but only worked 32 per cent. of all the hours in a year.

In neither of the above cases relating to engineering works was the night shift as large as the day shift; had it been a complete double shift the load factor would be well over 50 per cent.

The load factor of individual consumers may not often be very good, and the diversity factor becomes of very great importance. I am inclined to agree with Mr. John F. C. Snell, who said, during the discussion on my paper, that power companies will get a good load factor due, not to the high load factor of individual consumers, but to the diverse nature of their demands. If that is really found to be the case, then the load factor of individual consumers will not be a matter of importance to the supply authority, and tariffs based on the load factor of the consumer, such as the demand indicator system, may want modification. This may have been Mr. Gibbings's experience at Bradford, or, at least, what he anticipated, when he initiated the very low tariff of 1d. per unit, level rate, which is, I believe, lowest of any supply price in the country, lower even than the power companies, for load factors less than 40 per cent.

Andrew Stewart.

Distribution Cables for Three-Phase Working.

The advice given in the footnote to my letter in your last issue seems to me, under the circumstances, scarcely logical.

The original article on January 10th was *unsigned*, and therefore appeared upon your editorial responsibility; the points upon which I desired information were therein stated very definitely and strongly, namely, that the jointing was simple, and that the conductors were not cut at the consumers' boxes.

As, no doubt, you satisfied yourselves upon these points before endorsing the claims, and as you manifestly desired to benefit the industry by bringing the improvements forward publicly, I am at a loss to know why there should be any hesitation in stating the method in which the work is carried out.

I, therefore, think that the proper place for the explanation to be given is in your columns, as it is there that the subject was first given publicity.

M. R.

[We are sorry our correspondent is dissatisfied with our suggestion; we regret, however, that we are at present debarred from giving details regarding the method of jointing, as the devices in question are not yet fully covered by patents.—Eds. Elec. Rev.]

Tunbridge Wells Telephones.

In your report of the Tunbridge Wells telephone inquiry there seems to be a difference in the figures given by Mr. Bennett and the borough accountant.

The former, in answer to a question, page 400, says: "The number of subscribers is 380." The town accountant, on the other hand, in his statement, says: "533 revenue-earning lines."

What might be the explanation of this, do you think?

Spectator.

The Testing and Management of Electric Motors.

The thanks of your readers are certainly due to Mr. White for the very entertaining contributions he has made to your columns on the above subject.

As Mr. White is still sceptical about the accuracy of Mr. Poole's equation, perhaps the following method of arriving at it may explain the presence of figure "4." Mr. Poole's formulæ enable the approximate *commercial* efficiency of a motor to be obtained without running it at full load, the assumption being made that all the losses are constant from no load to full load.

Now, commercial efficiency $= \frac{\text{output}}{\text{input}}$, or, put in another way, commercial efficiency $= \frac{\text{output}}{\text{output + losses}}$.

$$\text{Commercial efficiency} = \frac{\text{output}}{\text{output + field loss + armature } C^2 r \text{ loss + core, eddy current, windage and friction losses.}}$$

If Mr. White agrees so far, the rest is easy. Putting the thing into symbols, let—

C_f = field shunt current.
C_l = armature current, motor running light.
C = full load armature current.
E = supply volts.
W = output of motor in watts.
r = armature resistance.
w = core, eddy current, windage and friction losses in watts.

$$\text{Commercial efficiency} = \frac{W}{W + E C_f + C^2 r + w}.$$

$$C = \frac{W + w + C^2 r}{E}.$$

This is an adfected quadratic equation in C, and is easily solved by the rules for quadratics given in any elementary book on Algebra.

Arranging the terms in proper order we get:—

$$C^2 - \frac{E C}{r} = -\frac{W + w}{r},$$

and adding $\frac{E^2}{4 r^2}$ to both sides of the equation to make the left-hand side a perfect square, we have

$$C^2 - \frac{E C}{r} + \frac{E^2}{4 r^2} = \frac{E^2}{4 r^2} - \frac{W + w}{r}.$$

Taking the square root of both sides of the equation we have

$$C - \frac{E}{2 r} = \pm \frac{\sqrt{E^2 - 4 r (W + w)}}{2 r},$$

and finally we get

$$C = \frac{E - \sqrt{E^2 - 4 r (W + w)}}{2 r}.$$

H. W. W. Dix.

Cheddar, *March 14th*, 1902.

PARLIAMENTARY.

Northumberland Electric Power Bill.

(*Continued from page* 415.)

Mr. Browne was recalled to give further evidence with regard to the estimate he had made that there would be an immediate demand for 8,500 kw. of energy. He said that taking an average of four 8-c.p. lights per house, he considered there would be a demand for lighting purposes of 2,400 kw. The Northern Counties Company had a system of penny-in-the-slot meters, and electricity was used in the very poorest houses. In no case was the charge for gas less than 3s, and a large proportion of the houses, about ⅘ths, had no gas. The Northern Counties Company was promoting a Bill for the establishment of an electric tramway service, and he anticipated that 1,000 kw. would be required for those tramways. The promoters had been approached by six colliery companies who wanted a supply of electricity for various purposes. The supply was in most cases needed for lighting, and in others the supply was required for tramways, but in some cases it would be used for pumping. He estimated that those collieries would take 4,800 kw. which would be used underground. The date

of the meeting at which the promoters resolved to proceed with the Bill was April 4th, 1901, but they had been considering the scheme since the previous August.

In cross-examination by Mr. Pember, Witness said he thought that electricity for domestic lighting would be cheaper than gas at 3s. per 1,000 ft. They had not settled with the colliery owners as to the price they were to pay. The colliery owners had not absolutely asked for 4,800 kw., but they had stated their requirements.

Replying to the Chairman, Witness said electricity obtained for 1d. from a slot meter would last 5½ hours.

Mr. Ridley Whoban, of the Ashington Collieries, which are the largest collieries in Northumberland, said he thought they would be able to take 1,250 h.p.

Mr. Clement Wilson Fairweather, joint engineer with Mr. Browne, of the Northern Counties Electricity Supply Company, said that company had a prospect of a considerable amount of business over the area for which they had already obtained provisional orders. They were applying for nine orders in Durham and five in Yorkshire. An agreement had been entered into by the Northern Counties Company with the promoters of the Bill before the Committee, to take a supply of electricity in bulk. His company had adopted the penny-in-the-slot system in Blyth. They had installed 40 meters in cottages in four months. In Durham and other places they had put in over 180 meters that year. They were making arrangements for a large demand which they anticipated; having now 500 meters on order. The consumer received ⅛th of a unit for every 1d., which was sufficient to light an 8-c.p. lamp for 5½ hours. The company paid the whole cost of the installation, and on an average they received at Blyth £2 12s. a year from each user of the slot meters.

Further witnesses were called bearing out the evidence given by Mr. Browne and Mr. Fairweather, and the case was then closed for the promoters of the Northumberland Electric Bill.

The promoters of the Newcastle-on-Tyne Electric Supply Bill then proceeded to call their witnesses.

Mr. Chas. Merz, consulting engineer at the company's supply station at Wallsend, said he thought the best way of securing a cheap supply of electrical energy was to take it as far as possible from one station. It would be an advantage to outlying districts to take their supply from a station where the cost had been already reduced to a low figure. He proceeded to give a history of what his company had done already. If the extended area they asked for was granted, their generating stations would be practically in the centre of their district, and their long cables would only have to supply a comparatively small amount of energy. With an agreement made with the Durham Company and the added area they were now asking for, their whole system of supply would unite the three elements of economic production. Economic production depended, first on the size of the generating station, and, secondly, the load factor had to be considered, and with the extended area his company would have not only an increased load factor, but a higher diversity factor. The third element was the compactness of the area supplied, and from that point of view his company, by commencing with a high load density, would be in a position to at once supply the district at a very low price indeed. This company having already a "fat" district, would be able to serve very much better a "lean" district than a company which dealt with the "lean" district only. The addition of the "lean" district would be no disadvantage to the "fat" district, but would be an enormous benefit to the new area. They would be in a position to supply energy far more rapidly than a company coming new to the district, and could supply energy immediately, and offer it at a very low price. The present Bill had really originated at the request of would-be consumers. They had arranged to supply manufacturers with polyphase motors having a considerable advantage over continuous current motors. A site had been obtained for erecting a new and enlarged generating station, and for that purpose they had purchased 13 acres of ground. The stations, at first, would have a capacity of 2,500 h.p., but if they got the new area asked for, it would be increased to 5,000 h.p. During the last nine months their charges had been very much reduced, and that showed that the amount of output had a great deal to do with the cheapness of production. If the Bill passed, the supply given by them in a month would be chiefly to colliery owners, and in order to induce them to take a supply, a very low price would have to be quoted. He had formed an estimate of the amount of energy which they would be called upon to supply immediately, and he must say the figures given to the Committee by the other side were very much exaggerated. Collieries had already a large amount of plant, and it was not likely they would at once change their machinery and adopt electricity throughout the works, however great the advantages offered; and even if they did, prices were too high. If a company succeeded in getting orders for 2,000 or 3,000 h.p. within two or three years they would do well. It was impossible for a company which had only that demand to supply the energy as cheaply as a company which was already established and could supply it from an existing generating station. It was proposed to have the three-phase system. Their present voltage was 6,000, which would be transformed for the purpose of the new area to 20,000. It would again be reduced by sub-stations when it had reached the area of distribution. The company would be able to give direct current if wanted for tramways. The prices charged by his company in Newcastle compared very favourably with those charged by the other company in Newcastle. It was said the maximum prices in the Northumberland Power Bill were lower than those in his company's Bill; but as a matter of fact, the prices to be paid by the consumers to the distributor would not be regulated by the maximum in the Bill.

In cross-examination, Witness admitted that when they had a Bill before Parliament in 1900 he stated that the district north of his present area was an agricultural one, and there was no one worth supplying.

Mr. Merz was cross-examined at considerable length by Mr. Baggallay, and said it was true the County of Durham Company, with which his company had a draft agreement, had already companies in Gateshead, Jarrow, and Durham, which were affiliated, and the position between those companies was analogous to the relations between the Northumberland Electric Power Company and the Northern Counties Company. His company would supply energy in bulk to the Durham Company. His company sold 1,400,000 units of electricity in Newcastle last year, but the total amount they sold was up to 3,000,000 units. His company supplied the Walker Company at a charge of 6 per cent. on the capital expenditure at the generating station used by them, plus the average cost of generation per unit.

Dr. Merz, the chairman of the Newcastle Supply Company, was called, and said that the Walker Gas Company was charged the actual cost of the electricity, and added to that a charge of 6 per cent. upon the capital which was represented in the generating station. That worked out last year at practically 0·7d. for cost and 0·7d. for interest, but, at the present moment, it had been reduced to 0·35d. for cost and 0·35d. for interest.

Mr. W. Madgen, one of the directors of the County of Durham Electrical Supply Company, said his company had been negotiating with the Newcastle Supply Company with a view of getting a supply of electricity in bulk from them. The Durham Company had a rich dense load on the south side of the Tyne, close to the river, and it was in view of that density that they went to Parliament in 1900 for power to construct stations to supply the concentrated load. To get over the period of construction, it would be a great advantage to have a supply from the Newcastle Company. His company would take 1,000 kw. at a charge of £3 10s. per year per kilowatt demanded. In addition to the standing charge, they would pay 0·35d. per unit taken. He expressed the opinion that the Newcastle Company would be able to give a cheaper supply than the Northumberland Power Company.

Several witnesses who are customers of the Newcastle Company were called, and spoke to the satisfactory nature of the supply.

Mr. Ferranti was called and examined as to the merits of the rival schemes, and expressed the opinion that the Northumberland Power Company had not a very good chance of succeeding, because their suggested district was a poor and scattered one, and they had not that advantage of a concentrated and valuable district along the Tyneside. He thought the power company would not for a long time be able to get their cost down to that of the Newcastle Supply Company.

Mr. Pember addressed the Committee for the promoters of the Newcastle Electric Supply Bill, and said there could be no doubt that the Newcastle Supply Company had done more in the last few years than any other of the great electric companies in the whole of the United Kingdom. There was no company they could compare with it in point of rapidity of development. He was not aware that the company's new area was not so far to the north as that of the Power Company, but there was no reason why the district should not be further extended. His company's arrangement with the Durham Company showed that not only were they at work thoroughly in their own district, but that they were at work on such a scale as to enable them to supply power at a low rate outside. He thought that the worst that was suggested of the agreement was that the price amounted to 60, or he would put it at 80 if they liked, decimals of 1d. But that, he contended, would give the Durham Company a chance of distributing the energy at a profit to themselves, and at a reasonable price to the consumers. With their plant of such a character as it was, the Supply Company, by reason of the area and scale on which they conducted their operations, could do two things. First, they could offer electricity at an exceptionally low price, which was proved not only by the low prices at which they offered energy to the Durham Company, but by the price at which they supplied their customers; and, secondly, they could meet any demand which they might expect from their present district or from any other. They had brought down the cost of production to 0·35d., and the reduction in the last nine months represented no less than 50 per cent., the sole reason for that being the increased output, and that showed the value of a large and productive district. He wished the Committee to consider the financial position of the Supply Company. They had expended £500,000, and had already a reserve fund of £75,000. Their new £5 shares were issued at £7, and were now worth £8 15s. in the market, and he would like to know if they thought any company could be in a better position to raise fresh capital? In order to justify their position, it was necessary for the Power Company to place before the Committee very large estimates of the amount of energy which would be required, and their engineers did that. They informed the Committee that a generating station having a capacity of 8,500 kw., represented an enormous output during the year, which was by way of showing the Committee that the demand would be such as to make a low price possible. But no colliery had told the Power Company what amount of energy it would take. The estimates were vague, and based on no information at all. The immediate demand, he believed, would be comparatively small, but as an addendum to the Supply Company's present demand, it would become part of a large and lucrative business, well established, and the consumer in the new district would be able to share the advantage of the low price enjoyed by the consumers in the Supply Company's present district. He thought it was perfectly easy to see the advantage to the new district, but it was not quite so easy to make people understand that the old district would also benefit. There would be, however, a distinct advantage to the latter. The Supply Company would get as an addition to their load factor, whatever demand there was from the new

district, and that increase in the load factor would enable them to sell to everybody at a lower price than before. Until they reached 100,000 H.P., which he did not think would be for years, they could go on cheapening production. If the Committee passed the Power Bill, one of the two things must happen; either there must be higher prices in the new district, or should the Power Company charge low prices, it would mean commercial failure.

The CHAIRMAN said it must be remembered that the Power Company had stated that they were prepared to compete with the Supply Company in the new area.

Mr. PEMBER said he did not think that would be advisable. He had never known Parliament to pass the Bills of two supply companies for one district. It was not that he was afraid of the Power Company. If both Bills were passed he knew which would be carried out, and the one which would not, would not be his.

Mr. BAGGALLAY, K.C., on behalf of the Northumberland Power Company, said that as far as the promoters of the Power Bill were concerned, they were quite prepared to accept competition. If their case was right that the district could best be supplied by the consumers supplying themselves, they had no reason to fear the competition of the Supply Company. On the other hand, if the Supply Company were right in their conjecture that owing to their having large works already established in Newcastle, they could better supply the new area sooner and cheaper, so much the better for the consumers who promoted the Power Bill. Their object was to get a cheap supply for the district. The Power Bill was promoted by important substantial gentlemen in the district, and nearly all of them were locally interested. They had got works already going at Blyth capable of carrying on a fair business while new works were being erected. If the case put forward by the Supply Company was correct, the logical meaning was that the right thing to do was to go on extending gigantic undertakings until eventually there was only one power station for all England.

The Committee having deliberated in private for a short time, the CHAIRMAN announced that the Committee were of opinion that the preamble of the Newcastle-upon-Tyne Electric Supply Bill was proved, subject to there being a clause in it similar to the one in last year's Yorkshire Bill, and subject to the consideration of prices set forth in the schedule. They were of opinion that the preamble of the Northumberland Power Bill was not proved.

The clauses were then approved, and the Bill was ordered to be reported to the House.

MIDDLESEX COUNTY COUNCIL TRAMWAYS.

MR. E. WASON'S Select Committee of the House of Commons, on 11th inst., commenced the consideration of the Middlesex County Council Bill, which deals with the tramways in the county. Amongst the opponents were the Ealing Borough Council, represented by Mr. Glen; the Twickenham, Heston and Isleworth Urban District Council, represented by Mr. Morton Smith; the Acton Urban District Council, represented by Messrs. Hutchinson and Neilson; the Hendon Council, represented by Mr. Oliver; the Chiswick Urban District Council, represented by Mr. Vesey Knox; the Wood Green Urban District Council, represented by Mr. Forbes Lankester; and the Tottenham Urban District Council.

Lord ROBERT CECIL, K.C., who with Mr. Moon appeared for the promoters, said that the substantial object of the Bill was to enable the County Council in certain circumstances to purchase by agreement the tramways in the County. The objections raised generally by the local authorities were that such a proposal interfered with the general law, and that it would be an injury to the local authorities. He submitted, however, that the circumstances of Middlesex were of a special character, for this had several times been recognised by Parliament, who had treated it differently from other Counties. The population had immensely increased of late years owing to the growth of the suburban parts of London, and increased means of communication with London were urgently needed. The County Council had been constituted the light railway authority, and had obtained powers to construct a number of light railways; but they had no powers under the Tramways Act, and were unable, even although all parties agreed, to take over tramways. The light railways which had been sanctioned would form connections with existing or authorised tramways, and were intended eventually to form part of a general system of intercommunication, and it was expedient that the County Council should either solely, or in conjunction with the local authorities, exercise control over the system, and that they should, under certain circumstances, become the owners of the tramways. Therefore it was proposed under the Bill that the County Council should be constituted a local authority within the meaning of, and for certain purposes of the Tramway Act, 1870, and with the following powers:—First, to buy tramways compulsorily in certain circumstances, and subject to the conditions imposed by Sec. 43 of the Act; secondly, to purchase by agreement under Sec. 44; and thirdly, to deal with tramways by way of leasing them after they had acquired them under Sec. 19 of the Act.

Mr. J. BIGWOOD, M.P., chairman of the Parliamentary Committee of the County Council, was called in support of the Bill, and said that the County Council had no desire to interfere with the existing rights of the local authorities. They simply wanted powers which they could exercise with the consent of the local authorities. He considered that the question of facilities for intercommunication between London and Middlesex was a most important one, and that it was a means by which the housing problem could be solved. There were 35 local authorities in the county, of whom eight were opposing the Bill.

In cross-examination, WITNESS admitted that the rateable value of the local authorities opposing was about one-third of the whole rateable value of the county. They had entered into an agreement with the London United Tramways Company, under which they bound themselves not to promote any tramways in the southern portion of the county, and to oppose schemes other than those of the United Tramway Company, and this would give a monopoly to the company in the southern portion of the county till 1919, while the County Council would have a monopoly in the northern part. They did not intend to work the tramways themselves.

Mr. LITTLER, K.C., was called and gave evidence of a similar nature to the last witness.

Sir ALEX. BINNIE, late chief engineer of the London County Council, expressed his opinion that is was important that the County Council should have control of the tramways in Middlesex just as the London County Council had control of those in London.

The Committee adjourned.

On the resumption of the proceedings on 12th inst. Mr. MOON said it was proposed to insert a clause in the Bill which would make it clear to everyone what were the intentions of the County Council. At present Clause 2 was as follows:—"Subject to the provisions of this Act the Council shall from and after the passing of this Act, be deemed to be a local authority, and the County of Middlesex shall be deemed to be the district of such local authority within the meaning and for the purposes of Sec. 19 ('local authority may lease or take tolls'), Sec. 43 ('future purchase of undertaking by local authority'), of Sec. 44 ('power of sale'), of the Tramways Act, 1870, in relation to any tramways authorised or to be authorised in the said county by any Act passed or provisional order confirmed by Parliament before or after the passing by Parliament of this Act with which those sections, or any of them, are, with or without modification, incorporated, and the Council may (subject as aforesaid) exercise in respect of such tramways the powers vested in local authorities by those sections, with such modifications as aforesaid, if any, accordingly." It was proposed to add to that clause the following:—"Provided always that the powers by this Act conferred upon the Council with respect to the purchase of tramways shall only be exercised with the consent, in writing, of the local authority of the district in which the tramways proposed to be purchased are situate."

Considerable discussion took place amongst the counsel representing the various local authorities opposing, and Mr. VESEY KNOX argued that no good cause had been shown why the ordinary law should be changed.

After the Committee had consulted in private, the CHAIRMAN announced that they had found the preamble proved.

It was intimated that the opponents would not further contest the clauses at that stage, and the Bill was ordered to be reported for third reading.

METROPOLITAN DISTRICT RAILWAY BILL.

THE Standing Orders Committee have reported that, with regard to the additional provision asked for by the promoters of this Bill, Standing Orders should be dispensed with, and that the parties be permitted to introduce their additional provisions if the Committee before whom the Bill will come think fit. Amongst the things sought for in the new provision is the confirmation of the award of the Board of Trade as to the system of electric traction to be used on the District and the Metropolitan Railways.

LONDON COUNTY COUNCIL TRAMWAYS AND IMPROVEMENTS BILL.

THE Standing Orders Committee of the House of Commons has reported that the Standing Orders ought to be dispensed with and the parties be permitted to proceed with their Bill, provided that powers to construct Tramways Nos. 1, 2, 3, 4, 6, 6*a*, 6*b*, 8, 9, 10, 12 and 13 be struck out of the Bill. Amongst the proposed tramways which will thus have to be dropped this session are a line from Stoke Newington to Hackney; one from St. Pancras to Marylebone; one from Marylebone to Paddington; a line from Paddington to Maida Vale; from Bridge Road, Chelsea, to Grosvenor Road, Westminster; from Vauxhall Bridge Road to Grosvenor Road; a line from Putney to The Grove, Clapham Common; one from Streatham High Road, terminating at the county boundary; a long line wholly in Greenwich; one commencing in Greenwich and terminating in Charlton; and one from Deptford to Lewisham High Street.

CORNWALL ELECTRIC POWER BILL.

THE Cornwall Electric Power Bill came before the Chairman of Ways and Means in the House of Commons as an opposed measure. The Bill incorporated the Cornwall Electric Power Company, with a capital of £450,000 and the usual borrowing powers, and the area of supply scheduled is practically the whole of the County of Cornwall. Two generating stations are proposed to be erected. The Bill was ordered to be reported for third reading.

ERDINGTON TRAMWAYS.

THIS Bill, which empowers the Urban District Council of Erdington to construct and make tramways, came before the Chairman of Ways and Means as an unopposed measure on Thursday last week. In the estimates accompanying the Bill, £52,500 is set forth for the purchase of land and construction of tramways, and £50,498 for tramway purposes. The Bill was ordered to be reported for third reading in the House on Commons.

Manchester and Salford Tramways.

On 13th inst. a Select Committee of the House of Commons, under the chairmanship of Col. Bowles, commenced the consideration of two important Bills, viz., the Salford Corporation Bill and the Manchester Corporation Tramways Bill. The Bills, which were taken together, raise a somewhat novel point with regard to municipal tramways, viz., the constitution of a joint board of control. The Salford Bill asks for power to construct tramways, &c, and to allow the Corporation running powers over the Manchester Corporation's tramways, and provides for the constitution of a joint board, to consist of representatives of the two Corporations, for the working of the two tramway systems. On the other hand, the Manchester Corporation Bill seeks to empower the Corporation to purchase the Manchester Carriage and Tramways Company's tramway, which is in the township of Broughton and the Borough of Salford. The promoters also seek to extinguish the right of the Salford Corporation to purchase such line, or, failing the obtaining of such a power, that the Salford Corporation should have running powers over the line. Mr. Balfour Browne, K.C., Mr. Freeman, K.C., Mr. Moon, and Mr. Roe Rycroft were for the Salford Corporation; Mr. Pember, K.C., Mr. Lewis Coward, K.C, and Mr. G. Rhodes for the Manchester Corporation; Mr. Hutchinson for the Swinton and Pendlebury Urban District Council; and Mr. Forbes Lankester for the Stretford Urban District Council.

Mr. Balfour Browne, in opening the case for the Salford Corporation, said the first tramways were constructed in Manchester and Salford in 1877, when, although Corporations could acquire tramways, they were not allowed to work them unless they failed to get a tramway company to lease them. At that time the whole of the tramways in the two boroughs were leased to the Manchester Carriage and Tramways Company. The Standing Order was repealed, and in 1896 both Corporations applied to Parliament for powers to work the tramways in their respective districts when the company's lease fell in. The Carriage Company at the same time applied for power to Parliament to electrically equip their tramways, but the Bill was opposed by both Corporations and rejected, while each Corporation got powers to work the tramways themselves. Manchester had gone forward, and had agreed with a number of the outside local authorities to work the tramways. At present the state of things had reached a public scandal, for the cars of each Corporation stopped when the boundary was reached, and passengers had to change from one car to another. What Salford wanted, and what the public desired, was through communication between the two boroughs from one end to the other, and in order to secure that they proposed to set up the machinery of a joint board. How that board should be constituted was to be determined by a scheme to be drawn up by the Board of Trade. He did not suppose Salford would get equal representation, but he thought if such a board was formed there would no longer be hostile interests. A standing arbitrator was, however, under the Bill to be appointed to settle any matters in dispute. He thought that running powers only would not meet the case, but that there must be a joint board.

Mr. Evans, the Town Clerk of Salford, was called, and bore out counsel's statement.

Mr. Coward said the position of the Manchester Corporation was that if Salford had running powers over the Deansgate line, and Manchester running powers on the Bury New Road, any question regarding rent and conditions should go to a Board of Trade arbitrator, and that would meet all the requirements of the case.

Mr. Pember suggested that if the proposal for a joint board was withdrawn, a resumable *modus vivendi* between the two Corporations might be arrived at.

Mr. Freeman declined to withdraw this proposal, but was willing that the joint board should go if he could arrange terms with Manchester.

The Committee decided to adjourn, to give the two parties a chance of coming to some agreement.

On the resumption of the proceedings on 14th inst. Mr. Balfour Browne said that unfortunately no agreement had been arrived at. He was not wedded to a joint board, and if any machinery could be invented by which Salford got through communication, he was prepared to accept it. Salford proposed that there should be an interchange of through traffic upon such routes and upon such terms and conditions as might be agreed upon, or failing agreement as should be settled by the Board of Trade. This was not acceptable to Manchester, but Manchester offered running powers over certain lines for through cars only, and in exchange wanted running powers over two lines. Part of their offer was that each Corporation was to maintain and electrically equip the tramways in its own district; the price of electric current in each case not to exceed that paid by the operating Corporation in its own district.

Mr. Pember said the only real requirement was communication between Salford and Manchester, and that the offer of the Manchester Corporation would bring about. There was no through traffic worth having to places beyond Manchester.

Further evidence was then called.

Mr. T. T. Crook, M.I.C.E., consulting engineer to the Manchester Tramways and Carriage Company, said his company worked about 154 miles of tramways, of which 23 miles were in Salford. The Manchester Corporation worked about 150 miles of tramways, and Salford about 50 miles. He advocated the establishment of a tramway Board for Manchester and Salford.

Mr. D. Boyle, chairman of the Tramways Committee, was the first witness called on behalf of the Manchester Corporation, and described the tramway system and the negotiations which had taken place with the Salford Corporation. The Manchester Corporation had carefully considered the joint board scheme, and had come to the conclusion that it was an impossible suggestion.

The Committee again adjourned.

On resuming on Monday, Mr. Boyle was cross-examined by Mr Moon for the Salford Corporation. He said he objected to a joint tramway board on many grounds, as, in his opinion, no other authority than the Manchester Corporation ought to be allowed to have control of the tramway service in the city. They were under statutory obligation to do the work, and also under an obligation not to sub-let, and he did not know that they could be relieved from that by handing the system over to a joint board. Manchester recognised that there were public requirements on the part of Salford, which would be met by giving running powers into the centre of Manchester, and that they were ready to agree to.

Mr. Alderman Hoy, the Lord Mayor of Manchester, gave similar evidence. He said that as to giving through routes between the two systems at present, they did not know what was practicable and what was not, and before making any change, he thought it would be desirable to wait until electric traction had been introduced on all the routes, and until its possibilities had been established. He objected to a joint board, because it would supersede the action of the municipal authority.

In cross-examination, Witness said the Manchester Corporation did not object to a through service; all they did was to point out the impossibility of giving such a service under present conditions.

After a consultation between counsel, Mr. Coward submitted the following clause on behalf of Manchester, which he said he thought would meet the requirements of the case:—"The Board of Trade are hereby authorised, on the application of either Corporation, to consider and determine if, and to what extent there shall be an interchange of through traffic between Manchester and Salford, and if so to settle the routes, terms, and conditions thereof."

Mr. Moon suggested a clause commencing, "There shall be an interchange of through traffic upon such routes, terms, and conditions as may be agreed upon."

Mr. Coward said he could not accept such a peremptory clause.

Eventually, after discussing in private, Mr. Pember said the following clause had been agreed upon between himself and Mr. Balfour Browne:—"There shall be an interchange of through traffic, so far as reasonable, upon such routes or portions of routes, and upon such terms and conditions as may be agreed upon, or failing agreement, as shall be settled by the Board of Trade." The Committee then adjourned in order that the question might be definitely adjusted between the parties.

London United Tramways Bill.

Mr. Campion, one of the Examiners of Standing Orders, had the above Bill before him on Monday on a question of compliance with the necessary Parliamentary requirements. The Bill proposes the construction of a series of tramways through portions of Hammersmith, Barnes, Richmond, the Maldens and Wimbledon. The idea of the extensions is to link up the various tramways, light railways and proposed tube railways in the districts which have already received the sanction of Parliament, and which will have a road mileage of nearly 100 miles. Mr. A. Pitt, representing Messrs. Sherwood and Co., Parliamentary agents, who appeared for the promoters, produced the consents of the local and road authorities to all the proposed extensions except four—Nos. 1, 2, 3 and 8. Those sections would accordingly be withdrawn for the present. The estimated cost of construction of the remaining extensions, including road and street widening, was about £300,000. Mr. Clifton Robinson, the company's engineer, having given evidence relative to the plans, surveys and engineering details, the Bill was ordered to be reported as having satisfied the Standing Orders, with the exception of the four tramways withdrawn.

Kent Electric Power Bill.

The following local authorities have withdrawn their opposition to the Kent Electric Power Bill:—The Corporations of Rochester, Tenterdon, Lydd, Sandwich, Hythe, Chatham, Ramsgate, Canterbury, Gravesend, New Romney, and Faversham, and the Urban District Councils of Beckenham, Tonbridge, Sandgate, Sittingbourne, Northfleet, Dartford, Erith, and Chenton.

Medway and Thames Canal Bill.

This Bill has lately been considered by the Select Committee of the House of Lords presided over by the Earl of Dartney. The Committee on 10th inst. decided to recommend that it should be allowed to proceed. The Bill is promoted by persons interested in the trade of the Medway and the locality, and has for its object the construction of a canal from Rochester to a point on the Thames about three miles below Gravesend, a length of about five miles. Electricity is to be used for lighting and towage, and barges will be saved the journey of 35 miles round the Nore and the constant delay arising from fogs.

Croydon.—The Board of Trade approval having been received, the electric cars commenced running between West Croydon and South Norwood on Friday last.

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National Company for the Distribution of Electricity by Secondary Generators.

In the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy the other day, the hearing was resumed of the case in *re* the Companies' Acts, 1862 to 1893, and in *re* the National Company for the Distribution of Electricity by Secondary Generators, on the appeal of Mr. Adam Scott, a shareholder, from an order of Mr. Justice Wright in the Companies' Winding-up Court, dated April 17th, 1901, dismissing his petition to have the winding up of the company continued under the supervision of the Court, the company being in voluntary liquidation. Mr. Scott appeared in person in support of his appeal, Mr. Gore Browne representing the liquidator, the respondent of the appeal.

The grounds on which Mr. Scott asked for the supervision order were, that there were matters requiring searching investigation, which could only be obtained by a compulsory winding-up order; and, secondly, that such an order would tend to the recovery of a large sum of money, which would benefit the whole body of the shareholders. The hearing had been adjourned from March 1st to enable the liquidator to make a report as to the presents of shares and the other matters brought into question by Mr. Scott.

Lord Justice Vaughan-Williams said he did not think they ought to allow this appeal. He arrived at this conclusion with some reluctance, because he was by no means satisfied that the complaints which had been urged by Mr. Scott were entirely without foundation. More than that, he was by no means sure that the matters he complained of were not matters which, if investigated, might result in increasing the fund which would have to be dealt with in the liquidation. He did not, however, think that Mr. Scott had made out a sufficiently substantial case to justify their setting aside the existing voluntary liquidation. The appeal would be dismissed. Lords Justices Stirling and Cozens-Hardy concurred.

Poole and Bournemouth Electric Tramway Company, Limited, *v.* The Bournemouth Corporation.

In the Chancery Division of the High Court, the above action was referred to before Mr. Justice Swinfen Eady.

Mr. Warmington, K.C., (with whom was Mr. R. J. Parker) informed his Lordship that he understood that the defendant Corporation desired that the motion should stand over for a week. He raised no objection, and asked leave to amend the writ and the notice of motion.

Mr. Vernon Smith, K.C., (with whom was Mr. C. G. Church) stated that it was an injunction to restrain the Bournemouth Corporation from completing certain tramways in the borough, and it was very desirable that the motion should be heard as soon as possible. He should complete his evidence by Tuesday, so that the evidence on the other side could be completed by Thursday, and he suggested the motion might be heard on Friday.

The learned judge concurred, and the motion was accordingly adjourned for a week.

The Harburg India-Rubber Company and Ferdinand Winter *v.* Martin Brown.

In the Court of Appeal on 13th inst., before Lords Justices Vaughan-Williams, Stirling, and Cozens-Hardy, the case of the Harburg India-Rubber Company and Ferdinand Winter *v.* Martin Brown, was heard on appeal by the defendant from a judgment of Mr. Justice Mathew. The action was brought on a verbal promise by the defendant that he would give bills of exchange for a debt due to the plaintiff company from the Crowdus Accumulator Syndicate. The facts were sufficiently set forth in the judgment given by Lord Justice Williams. His Lordship said that the plaintiffs had supplied goods to the Crowdus Accumulator Syndicate, and the company did not pay what was due for these goods. The plaintiffs thereupon recovered judgment, and placed in the hands of the Sheriff, a writ of *fi. fa.* for the recovery of the debt. The Sheriff found that the works had stopped, and he did not take possession. Subsequently there was a meeting between Mr. Martin Brown, the defendant, and Mr. Ferdinand Winter, acting on behalf of the plaintiffs, and the result of that conversation, shortly, was that Mr. Martin Brown promised that he would give bills for the amount of the judgment debt, and it was said that that amounted to an oral promise to guarantee the judgment debt owing by the Crowdus Accumulator Company. It was said on behalf of the defendant, who was a director and a large shareholder in the syndicate, that this was a promise by him to make himself answerable for this debt, and came within the meaning of Section 4 of the Statute of Frauds, and that, therefore, the action could not be maintained, because the promise was not in writing. The plaintiffs traversed this contention, and submitted that it was a contract of indemnity. The question to be decided was whether or not this bargain came within the 4th Section of the Statute of Frauds. Mr. Justice Mathew had found that it did not, and he was sorry to say he could not bring himself to agree with that conclusion. He thought that the contract was one by which Mr. Martin Brown contracted to make himself answerable for the debt of the Crowdus Syndicate. This was a case in which they must find as a fact what it was the parties were dealing about, and it seemed to him plain upon the evidence that the only matter which was present to the mind of Mr. Martin Brown, and was presented by him to Mr. Winter, was this: "Will you forbear for a time; will you give this company, which I believe has a future before it, the opportunity of turning round. I believe, if this company has that opportunity, it will do well." That, it seemed to him, was the true meaning of the conversation, and to induce that forbearance, Mr. Martin-Brown said he would give bills which would secure the plaintiffs' payment at specified periods. That was really the whole of the contract, and there was neither purchase nor anything else outside this bargain. It was impossible to say that the mere fact that Mr. Martin Brown had financed to a large extent this Crowdus Syndicate, and that that was a motive for coming forward and bargaining for forbearance, made any difference as to the subject of the contract. The contract was simply to obtain forbearance, and if that was the true contract, he did not see how the Court could come to the conclusion at which Mr. Justice Mathew had arrived.

Lords Justices Stirling and Cozens-Hardy concurred, and the judgment of Mr. Justice Mathew was therefore reversed, and the appeal allowed with costs.

James Littauer *v.* J. Bakewell & Co.

This action, which was heard before his Honour Judge Lumley Smith, K.C., on 17th inst., was a claim for the price of goods sold (about £45) brought by the plaintiff, an electrical supplies merchant and importer, against defendants, who are electrical engineers. Mr. R. F. Colam (instructed by Mr. Herbert Oppenheimer) appeared for the plaintiff, and Mr. S. Mayer (instructed by Messrs Whitehouse, Rivers & Co.) for the defendants. It appeared from the evidence that in September, 1901, the defendants gave the plaintiff an order for cable for about £83. The defendants contended that the order was conditional on delivery being made on October 1st, and as the date was not kept, they purchased the goods elsewhere and cancelled the contract. They also contended that inasmuch as the plaintiff had up to date only delivered goods to the value of about £45, and had not carried out the whole of the contract, they were not liable and were at liberty to reject the goods. The plaintiff, on the other hand, maintained that the part delivery had been accepted and that he was entitled to payment. After a prolonged hearing, his Honour decided that he was not satisfied that the goods had ever been rejected, and that under the circumstances the defendants were bound to pay for what they had received. We learn that judgment was given for the plaintiff for the full amount claimed with costs.

Hughes *v.* Colwyn Bay Electric Light and Power Company Limited.

Before Mr. Justice Swinfen Eady in the Chancery Division on Tuesday, Mr. Douce moved for judgment in this action; the defendants appeared and consented. He asked specially that the receiver might be at liberty to sell by public auction and private contracts all the office furniture, &c., at once, as it would save considerable expense. The Judge refused to grant this request, which should have been made in Chambers. He gave judgment, however, in the usual form.

Overhead Wires.

In the Chancery Division, on Tuesday, Mr. Justice Farwell decided the action of the Finchley Electric Light Company, Limited, *v.* The Finchley Urban District Council, which was brought to obtain an injunction to restrain the Council from cutting the wires of the company erected across Regent's Park Road, Finchley. Our report of the case is held over until next week, but his Lordship, in giving judgment, held that the fee simple was vested in the Council, and therefore it had the right to prevent the stretching of the wires across the road. Accordingly he dismissed the action, but without costs.

BUSINESS NOTES.

Bankruptcy Proceedings.—Under the failure of J. H Redgrave, electrical engineer, late of 53, Regent House, Regent Street, W., and St. Olaf's, Gloucester Road, New Barnet, present address unknown, the first meeting of creditors was held on Monday at the London Bankruptcy Court, before Mr. Egerton S. Grey, official receiver. The receiving order was made on March 5th, upon the petition of Mr. J. W. Cridlan, a creditor, claiming £850, and proofs to the amount of about £5,200 in all have been tendered by creditors, a large number being in respect of mortgages. It will be remembered that the debtor possessed various properties at New Barnet, and mortgaged them over and over again to different persons. A warrant for his arrest in respect of those frauds has been issued, but to the date of the meeting, the debtor had not been apprehended. A discussion arose as to the position of the various mortgagees, and the chairman expressed the opinion that it would be a matter of considerable difficulty to ascertain who were the original mortgagees, many of the leases given by the debtor over the same property bearing the same date. There was a good attendance of creditors and their legal representatives, but it transpired that owing to the fact that many of the proofs of debt were not lodged in time, there was no quorum, and the meeting was adjourned for a week with a view to the appointment of a trustee and committee of inspection.

The public examination of Henry Van der Weyde was held on Tuesday at the London Bankruptcy Court, before Mr. Reginald

Linklater. The debtor, who applied to pass upon accounts showing liabilities £12,627, against assets 2s. 4d., stated in reply to the Official Receiver that he patented in 1877 an invention for taking photographs by the aid of the electric light. Being unable to obtain more than £1,000 for the patent, he decided to exploit it, and for that purpose he opened a photographic studio at 182, Regent Street, W., where he had carried on business ever since. He started on borrowed money, and had been in difficulties throughout, because, although the business was a profitable concern, he was constantly losing money over his inventions. In 1894 he promoted Cube Ice, London, Limited, to exploit his invention for trade-marking small cubes of ice by a process of injecting the mark into the interior of the cube. Four years later he promoted the Star Ice Company, Limited, to take over and work the patent. That company was now in liquidation, but it was confidently anticipated that a purchaser would be found for the patent, and the company's debts would be paid in full. Between 1894 and 1898 he expended £7,538 on the invention, and all that he had received in return was £2,700 in cash, and £24,000 Star Ice shares, to which no present value was attached. It was true to say that had he confined his attention to electricity as applied to photography, he would not be now before the Court. The examination was concluded.

The examination of H. Cooke, electrical engineer, Birmingham, was closed at the Birmingham County Court last week.

Dissolutions and Liquidations.—Crowther & Co.'s Electrical Industries, Limited, resolved, on March 13th, at Manchester, to wind up voluntarily, with Mr. H. W. Thomas as liquidator. Creditors should send particulars of debts, &c., to Mr. Thomas, 43, Lower Mosley Street, Manchester, by May 3rd.

The first meetings of creditors and contributors of the Electrical Regulating and Lighting Syndicate, Limited, are to be held at Liverpool on April 4th.

The Commercial Ozone Syndicate is winding up voluntarily, with Mr. W. W. Futcher as liquidator.

A meeting of the Kerby Bowen Electric Syndicate will be held at 90 and 91, Queen Street, E.C., on April 21st, to hear an account of the winding up from Mr. W. Roden, liquidator.

Books Received.—"Proceedings of the Incorporated Municipal Electrical Association for 1902 (Repayment of loans)." Also "Memorandum, Articles, List of Members, &c." Ipswich: W. S. Cowell, Limited, 1902. 1s.

"Industrial Re-distribution," by W. L. Madgen. London: Manual of Electrical Undertakings, Limited, 1902. 6d.

"American Commerce, 1821—1900," from the Philadelphia Commercial Museum.

"Elementary Electricity and Magnetism," by D. C. Jackson and J. P. Jackson. New York and London: Macmillan & Co., 1902. 7s. 6d.

Brockie-Pell Lamp.—The 200 arc lamps now being erected in connection with the Newcastle Corporation tramways are of the Brockie-Pell patent, manufactured and supplied by Brockie-Pell Arc Lamp, Limited.

Catalogues and Lists.—A small illustrated price list of electro-physical apparatus has been sent to us by Messrs. Clausen and v. Bronk, of Berlin. The contents include various apparatus for demonstration of telephony without wires.

Messrs. Royce, Limited, of Hulme, Manchester, have sent us a few stock lists of their continuous current "Royce" dynamos and motors.

We have received from the United Electrical Company, Limited, of Ujpest, near Budapest, two wall show lists of their incandescent electric lamps. One of these sheets shows lamps of many varieties of shapes, made for different voltages and candle-powers.

A new price list of Dia's patent "Impregnable" paper cables has been issued by the St. Helen's Cable Company, Limited. The waterproof cable is described, and Mr. C. H. Wordingham's report of tests thereof accompanies the list. Low tension single and concentric cables up to 500 volts, high tension concentric cables up to 2,000 volts, low tension triple concentric 500 volts, high and low tension three-core cables (500 volts), and low tension twin paper-insulated house wires for 500 volts are particularised in tabulated form.

The General Electric Company (1900) have sent us a copy of their March Progress leaflet, in which notices appear of about half-a-dozen of their specialities.

From the Cutter Company, of Philadelphia, we have received a copy of their four-language catalogue, giving full particulars of the I.T.E. automatic circuit-breakers.

We have received from the Electrical Company, Limited, a copy of their No. 5 price list, in which are very full details of the Luna arc lamps and lanterns, also accessories and spare parts. Self-focussing shunt and differential arc lamps for direct current, and self-focussing "Duplex" shunt lamps are described, also the Luna enclosed lamps for direct and alternating current; the accessories include resistances, choking coils and transformers, hoisting devices, contact couplings, &c. A number of diagrams show the more usual methods of connections for direct and alternating lamps. There is a handy finger index to the different sections.

The Langdon-Davies Electric Motor Company has issued a new reduced price list of single phase and two-phase motors.

Charles Bright & Co., Limited.—A winding-up order having recently been made against this company, the statutory meetings of the creditors and shareholders were held on 12th inst. at the Carey Street Offices of the Board of Trade, Lincoln's Inn Fields, W.C. Mr. A. S. Cully, Official Receiver, reported that owing to pending liquidations, the books of the company had been in Court for days together, and the Official Receiver's investigation was not yet complete. The company was promoted by Mr. Charles Bright in November, 1898, with a nominal capital of £200,000 divided into 20,000 shares of £10 each, to establish and carry on a financial business generally, and to deal with industrial undertakings and financial operations of all kinds. Mr. Bright applied for and took over the whole capital of the company, and he had stated that the company was formed in accordance with an arrangement between himself and some friends to acquire concessions in South American undertakings in which they were jointly interested. Mr. Bright was one of the original directors, but although he resigned in June, 1900, he continued to attend the board meetings, and was said to have influenced, to a great extent, the policy of the board throughout. The manner in which Mr. Bright's shares had been treated, together with other matters of transfers, book entries, loans, and exchange cheques, would have to be fully inquired into at a later date, and having regard to the claims of the trustee under Mr. Bright's bankruptcy, and to other pending litigations, he would not make any comments on the case at that meeting. The Chairman proceeded to give details of the various companies promoted by this company and Mr. Bright, among the number being the Buenos Ayres Electric Tramway Company, Limited, the Metropolitan Railway Company, of Buenos Ayres, Limited, and the South American Electric Company, Limited. Three accounts had been opened with Mr. Bright in the books of C. Bright & Co, Limited, and in the draft statement of affairs, prepared under this liquidation, that gentleman was returned as a debtor to the company for £58,507, the debt being treated as irrecoverable. The statement further showed unaccounted liabilities £93,379; fully secured debts £58,142, the securities being valued at £62,282; and a judgment debt of £2,300, of which £2,160 was expected to rank. The assets, exclusive of the amount due from Mr. Bright, consisted of cash at bankers 4s. 6d.; investments in shares, £1,993; the surplus of £4,140 from the securities held by the fully-secured creditors, and the concession from the Metropolitan Railway Company, of Buenos Ayres, Limited. No value was placed on that concession, but on the other hand, £685,000 was claimed by that company against this company, chiefly in respect of damages for breach of contract. Other proofs for considerable sums had been lodged, and as he had some doubt of their validity, he would admit them for voting purposes and leave the Court and liquidator to deal with them subsequently. The creditors selected the Official Receiver for the post of liquidator, but the shareholders nominated Mr. F. Hyland, chartered accountant, Cannon Street, E.C., and the Chairman reported that the facts would be laid before the Registrar, who would make the appointment in due course.

Directory.—We have received from the publishers (Serle Street, W.C.) a copy of the 1902 edition of *Street's Newspaper Directory* for Great Britain and Ireland. The year in which the different papers were established, publishing day, price, publisher, and latest time for receiving advertisements are given in a convenient form for ready reference.

Electrical Exhibition.—An exhibition took place last week at Lewes in connection with the electricity supply undertaking, which is in the hands of the County of Sussex E.P.D. Company. A large number of firms, both local and general, showed electrical appliances and fittings, and the exhibition, which was opened by the Mayor, attained a large measure of success.

Football and Ping-Pong.—We hear that Glover's Association F.C. played the return match with Royce's Works in Manchester on the 15th inst., and won by two goals to one. The teams afterwards had high tea together, which meal, by previous arrangement, was provided by the losers. After tea a ping-pong match was played, the cable-makers again worsting the dynamo-builders by 78 points to 65. It may be mentioned that the previous football match was won by Royce's; tea on that occasion being provided by Mr. E. A. Claremont, a director of both companies.

France: Duty on Motors.—The *Board of Trade Journal* says that the Paris Chamber of Commerce has just furnished a report to the Minister of Commerce concerning the advisability of placing a duty upon electric motors weighing less than 10 kilos. As the parts utilised in the make-up of a motor are dutiable, and the spirit of the law of 1892 was to place a duty upon all appliances imported for use in a commercial sense, the Customs Committee of the Paris Chamber gives its opinion as favourable to these small motors being classified with motors weighing from 10 to 50 kilos., and consequently paying the same duty, viz., 80 frs. the 100 kilos. (tariff minimum). The main argument advanced for this proposed new duty is that the French constructor is unable to make small motors at a normal price, owing to having to pay duty on the parts imported, whilst the complete motors are allowed to enter the country free.

Imports of Foreign Electrical Plant.—The imports of foreign electrical goods and apparatus into this country during February last were on a relatively smaller scale than usual, amounting to a value of only £54,516, as compared with the £63,304 in January last and £97,296 in February, 1901. For the two months ending with the February, the imports have reached a total of £117,820, as contrasted with the £191,613 in the corresponding two months of 1901.

Irish Law Case.—In the Chancery Division, Dublin, on 11th inst., before the Master of the Rolls, a case of Callender's Cable and Construction Company, Limited, *v.* Killarney Electric Lighting Company, Limited, was heard.—Mr. Philip White, on behalf of the plaintiffs, said the application he had to make was

that, notwithstanding the provisions of an order, dated June 6th, 1901, inquiries be proceeded with with respect to the debentures on the property of the defendants. The order contained a proviso that these inquiries were not to be proceeded with until further order, with a view to a settlement of the action; but there was no possibility of settlement. There was another application that the plaintiffs be at liberty to apply in the name of the defendants for the lease of the water power. There was a third application that the plaintiffs might be declared entitled to salvage in respect to £125 expended in machinery, £40 advanced to the defendants to pay wages to their employés, and £30 advanced for laying down cable, and costs.—Mr. Robert Doyle, for Mr. Leahy, said he had a claim against the company for £2,000.—The Master of the Rolls said that his opinion was, that the claims made on the head of payments were not salvage claims; but he would reserve that question. The other branch of the application he would grant.

Clacton.—A L.G.B. inquiry was held last week into the application of the U.D.C. for consent to the letting of certain land on the West Greensward Cliff for the purpose of an electric stairway. The Reno Electric Stairways and Conveyors Company, Limited, were the proposed tenants. There was no opposition.

Electric Switch for Tramway Points.—An invention was privately tested in the Kirkstall Road tramway depôt, Leeds, some days ago by the inventors and patentees, Mr. T. B. Stewart, Mr. W. H. Turner, and Mr. R. E. Dixon, of the firm of Messrs. S. Dixon & Son, Limited, of Leeds. The invention has for its object the simultaneous automatic adjustment of points on the rails and overhead wires of an electric system by a simple device. A small switch, conveniently placed in front of the driver of the car, is connected by ordinary electric wires with the trolley-head, and so arranged that when passing a position a convenient distance in front of the points to be moved, by merely turning the switch the points on both the rails and the overhead wires are opened, while a second contact after passing the points closes them. The necessary batteries are enclosed in a box on the side of the pavement. In case of breakdown in the electric device, a hand lever can be used to set the points and overhead switch by one movement. At present this work has to be done by a man, who first moves the points on the rails with a pole, and then hurries back to the side of the road and pulls a string, which controls the points on the trolley wire. It is said that it costs the Leeds Corporation between £800 and £1,000 a year in salaries paid to men to perform this work in connection with about 80 sets of points.

Maxim Lamps.—The Sir Hiram Maxim Electrical and Engineering Company have just completed some very extensive alterations to their incandescent lamp factory at Gillingham Street, S.W., in order to cope with the growing demand for their various types of lamps The entire establishment has been fitted up with labour-saving tools and devices of all kinds, and the assistance of eminent scientific experts in incandescent lamp manufacture has been obtained. We learn that a special feature is the formation of the stem, all H.V. filaments being mounted upon a glass bar stem before the treating process takes place, which ensures the filament retaining the same shape in the bulb as it had while undergoing the above process; and, in the case of double filament lamps, as a result of this method the two filaments can be treated in series, thus both are equalised, and run at the same efficiency. We are informed that no untreated filaments of any sort are sent out from the works. The company claim for the Maxim lamp efficiency, long life, and that the candle-power is maintained to the end.

Raw Hide Gears.—Messrs. Geo. Angus & Co., Limited, of Newcastle-on-Tyne, report that business is very good at present. The Syracuse firm (by an arrangement with whom Messrs. Angus are now manufacturing these goods in this country) has just received an order from the British Westinghouse Electric and Manufacturing Company for 60 of its new process noiseless pinions for the equipment of the British Company's new plant. These pinions are to be used on motors for driving machine tools, electrical cranes, &c., and are for transmitting from 5 to 40 H.P.

"Samsohm" Trolley Insulating Material.—The General Electric Company (1900), Limited, have recently applied for and accepted the trade-mark name of "Samsohm" for the special insulating material of their trolley wire insulators. This material has successfully stood the tests of experience, and it is stated that customers are experiencing difficulty in specifying and obtaining this substance. It is hoped that these difficulties will be overcome by the adoption of this trade name, as trolley insulators will shortly have the word stamped on the insulating material. Some tests which have been carried out on Globe strain insulators made of this material, are considered to justify the construction of the word "Samsohm." We understand that an E.M.F. of 16,000 volts was applied without the insulation breaking down; a temperature of 270° F. was reached without any effect; and an assortment of the insulators were subjected to pressures as follows:—2-in. diameter from 5,900 lbs. up to 6,300 lbs, 2¼-in. diameter from 6,250 lbs. to 7,625 lbs., and 3-in. diameter from 7,500 lbs. to 7,540 lbs. On reaching the above strains the eyes broke in most cases, and in others the insulation split. It is therefore claimed that the material is far stronger, electrically and mechanically, than is necessary, even after allowing a larger margin for safety.

Summons.—Before Alderman Sir Reginald Hanson on Friday, at the City of London Police Summons Court, Thomas Brown, a foreman in the employ of the Charing Cross and City Electric Company, was summoned for leaving open a pit that was not properly protected. After hearing the evidence, Sir Reginald said he must inflict a penalty of 40s. and costs, and suggested the use of scaffold poles instead of the pieces of wood in use.

Trade Announcements.—The Fairbanks Company announce that, owing to their steadily increasing business in engineering tools and machinery, in addition to weighing machines, they have found it necessary to remove their London offices and warehouse to larger premises at 78—80, City Road, E.C.

The West Coast of America Telegraph Company and the Western Telegraph Company announce that they have now removed their offices to Electra House, Moorgate, E.C. The offices of the Globe Telegraph and Trust Company, Limited, will also be removed to Electra House, from to-morrow, Saturday, 22nd inst.

The Horsfall Destructor Company, Limited, announce that, owing to his Majesty's Office of Works having acquired their premises at 36, Great George Street, Westminster, they have secured commodious offices on the first floor at 19, Old Queen Street, Westminster, S.W., and on and after March 25th, 1902, all communications for the London office should be sent to that address.

Mr. J. W. Barnard, sole agent for the Electrical Power Storage Company's Q and V type storage batteries, informs us that he has recently acquired larger warehouse premises at 6, Great Winchester Street, E.C., where he holds a large stock of the batteries mentioned ready for delivery, charged or uncharged, at short notice. The additional premises acquired will give increased facilities for the repairing, hiring and recharging of batteries, and will enable him to meet the increased demand more promptly than heretofore.

ELECTRIC LIGHT AND POWER NOTES.

Ballymena.—The B. of T. is inquiring what steps have been taken by the U.D.C. in regard to the electric lighting order of 1897. The Council asks the Board to allow the order to remain in abeyance for another year.

Bath.—The Corporation has confirmed its action when sitting as the E.L. Committee last week, *re* obtaining tenders for the electricity supply undertaking.

Bexhill.—The U.D.C. is going to apply for leave to borrow £6,500 for electric lighting extensions.

Bolton.—A L.G.B. inquiry was held last week into applications to borrow £125,000 to meet future needs of the electricity department, of which £67,000 was for plant, £29,000 for buildings, and £22,000 for mains. The principal objects of the proposed loan were as follow:—New buildings, £29,616 (including new boiler house and engine house extensions); machinery, £67,305; boilers, &c., £24,705; and £22,550 for extension of the existing network, connecting boxes, meters, &c. The amount already sanctioned for electrical purposes is £147,972 (plus £50,000 for electric trams). Mr. A. A. Day, the electrical engineer, stated that the plant would include two 2,000-H.P. engines, two 1,200-KW. dynamos, and 20 Lancashire boilers. The original cost of the electricity works was £27,700, and of this amount a sum of less than £6,000 is now unaccounted for, £21,153 having been allowed for depreciation, whilst there is still £962 in reserve. The number of lamps has reached 88,841, and when the extensions are carried out the works will have a capacity of 7,000 KW., and the capital cost per KW. will be £46 2s. 9d., the lowest among the large stations in the kingdom. It is expected this year the cost of production will be 1d. per unit, the output 3,050,000, and the revenue £29,600. There was no opposition to the scheme.

Bridgend.—The D.C. has received an estimate of the cost of laying mains for the electric light scheme at £3,334 15s. 10d., and has decided to engage Mr. Sully, of Bristol, as electrical adviser.

Burslem.—The E.L. Committee has been empowered to engage an electrical expert to advise it, at a sum not exceeding 50 guineas.

Cowes.—A satisfactory arrangement having been entered into with the promoters, the consent of the Council has been given to the prov. order of the I.W. Electric Light and Power Company, which proposes to supply Cowes from the Newport generating station.

Exeter.—The L.G.B. inquiry into the application of the City Council for leave to borrow £70,000 for the erection and equipment of the new electricity generating station will be held by Col. Durnford to-day.

Falkirk.—It is proposed to put down two boilers of about 400-H.P. each and to advertise for three steam dynamos of 130-H.P. each.

Felling.—At a recent meeting of the Felling-on-Tyne U.D.C, it was decided in consequence of the unsatisfactory answers returned by the County of Durham Electric Power Distribution Company, with reference to the supply of electricity and the making of additional tramways within the district, that the sub-committee should open further negotiations with other companies.

Grimsby.—Last week Mr. M. K. North, L.G.B. inspector, inquired into an application of the Corporation for sanction to borrow £17,000 for the purposes of electric lighting. Since 1894 £55,000 has been borrowed for electric light and traction, and the present sum asked for was:—£4,100 deficiency and overspent in capital account for works now carried out, and £12,900 for the erection of an additional engine, with boiler, dynamos, and other things, to be added to the present plant at the electric lighting station. Mr. W. A. Vignoles, borough electrical engineer, gave evidence, and there was no opposition.

Heckmondwike.—The D.C. has decided to apply for borrowing powers for £6,500 for extension of works.

India.—The Electricity Bill was introduced at a recent meeting of the Legislative Council, and is intended to regulate the use of electricity for lighting and for electric traction. It will also regulate its use with regard to the existing telephone and telegraph lines. The Bill has been referred to a Select Committee for consideration "next cold weather."

The Rangoon Municipal Committee has decided to apply to the Local Government for a license under the Electricity Act for the supply of electric energy within the limits of the municipality, the maximum charge to the public being 8 annas per unit for lighting, and 4 annas per unit for power; the Municipal Committee being empowered to call for tenders for carrying into effect the powers granted by the license, and to reserve to itself the right to provide a share of the capital of any syndicate or company whose tender is accepted.—*Indian Engineering.*

According to a Government report, published in the *Times of India*, regarding the Cauvery Electric Power Works, whence the Kolar Gold Fields machinery is to be worked by electricity, the channels for conveying the water to the turbines are almost finished, and practically all the pipes and machinery have arrived. The transport across country of some of the machines has involved considerable labour, requiring elephants to drag them at the rate of about two miles a day—the railway being 27 miles from the works. The generating house and the transformers are well on the road to completion, and by May next it is expected that the work will be nearly finished. Difficulties, in the way of cholera, a bad type of fever, and retaining labour in an inaccessible site, have been very great, so bad, in fact, at times, when member after member of the supervising staff was disabled, as to render a breakdown imminent, but the energy and courage of Captain Joly de Lotbinière, and those employed under him, refused to recognise defeat

The Government of Mysore has issued a notification in regard to the wilful damage likely to be caused to the transmission line by ill-disposed persons. The line runs over a distance of 90 miles, and the Deputy Commissioners of the Bangalore, Kolar, and Mysore districts, through whose jurisdiction it passes from the Sivasamudram Falls to the Kolar Gold Fields, have been requested to direct the adoption of special vigilant measures with a view to seeing that the wires are not tampered with. All villagers are warned on no account to attempt to climb the poles or touch the line of conductors, even with a wooden rod, as this will mean instant death. In the event of the line falling on the ground, though it may look harmless, the fact of a person, or animal, touching it would result in death. Before the current is turned on handbills will be posted in every village along the line, pointing out that even a kite string may communicate the deadly "force," and that the line is not to be confounded with a telegraph line, with which the rural folk are so familiar. Apparently, some villagers have already failed to take warning of an early notice on this subject, as, quite recently, eight insulators were destroyed near the village. The continuity of working of the line is of vital importance. Originally, it was proposed to station a watchman every five miles along the line, but this has been abandoned, as the men could not be on duty night and day. As the matter requires early settlement, and as there are 210 villages within one mile of the route of the transmission line, Government has been finally pleased to order that the heads of villages concerned should be held responsible for any damage caused to the line, and that defaulting headmen be severely punished. All police officers are also instructed to inquire about the safety of the line whenever they are on beat. A subsidy of Rs. 2 a month will be paid to each headman for the additional duty involved, as long as the section of the line passing close to or across his village lands remains intact.

Kilmarnock.—The T.C. has resolved to rescind its previous resolutions with regard to electric lighting and traction and, if so advised, to bring forward a new scheme suitable to the burgh.

Kingston-on-Thames.—On Thursday in last week a town's meeting was held at which resolutions were passed calling upon the Corporation to rescind its order for 35 additional arc lamps, at a cost of £3,200, for public lighting, and asking for a thorough investigation into the Council's electric lighting undertaking, on which there was a loss of £2,721 last year. The opposition to the Corporation is alleged to be instigated by those interested in the local gas company, and a suggestion was made at the meeting that the Corporation should revert to gas for public lighting.

King's Lynn.—The T.C., with a view of inducing the Dock Company to take a supply for arc lighting or power purposes, has recommended that energy be supplied for lighting at 5d. per unit for the first three hours' use per day, and afterwards at 1d. per unit.

Kirkby Stephen.—The North-Eastern Railway Company have decided to light Kirkby Stephen Station and the locomotive works with electricity, power being obtained from the river Eden.

Leicester.—The accounts of the electric lighting department show that after paying £4,009 to sinking fund, there is a balance of £909 to be handed over to the relief of the rates.

London.—Bermondsey.—An inquiry was held last week at the Electrical Department of the B. of T., before the Hon. T. H. W. Pelham, Assistant Secretary, into an application by the Borough Council for an extended order affecting the parishes of Rotherhithe, St. Olave, St. Thomas, and St. John, Horselydown—the Council already possessing an order to supply electricity in part of their area, the parish of Bermondsey, which is about half the size of the new borough. Mr. Littler, K.C., appeared in support of the order; Mr. Balfour Browne, K.C, and Mr. Morse represented the County of London and Brush Provincial Electric Lighting Company, Limited, and Mr. Medcalf the London Electric Supply Corporation, in opposition; and Mr. Brown the South Metropolitan Gas Company. Evidence was given on behalf of the parties interested, and after hearing counsel, Mr. Pelham intimated that he would reserve his decision.

Camberwell.—A similar inquiry was held into an application of the Camberwell Borough Council for a prov. order to supply electrical energy throughout the whole of its district, part of which is already supplied by the Crystal Palace District Electric Supply Company, and other parts by the County of London and Brush Provincial Electric Lighting Company and the London Electric Supply Corporation. The application was opposed on behalf of the County of London Company, the Crystal Palace Company, and the South Metropolitan Gas Company. Mr. Medcalf represented the London Electric Supply Corporation, concerning whom there was a purchase clause in the order asked for, to buy them out of the district for £25,000. Mr. Williams, for the promoters, contended that it was right that a Borough Council, borrowing money on the security of the rates, should be authorised to compete with an existing company, the County of London Company, which had obtained a previous order, on the ground that competition was desirable in the public interest. The County Company were willing to sell on terms fixed by the order, but the Council was not willing to buy them, on the ground that it would be an unremunerative undertaking. Mr. Tagg, town clerk of Camberwell, stated that the benefit to the borough by the order asked for would be that they would get an effective supply of electric energy for £150,000, whereas to get the same supply under the County Company's purchase clause would cost £240,000 at the least. Mr. Balfour Browne, K.C., for the County of London Company, argued that the application raised the very important question whether there was to be competition between private enterprise and rate-aided authorities. He knew of no case where such competition existed, except in the light of purchase and on terms of purchase. Mr. Pelham reserved his decision.

Southwark.—An inquiry was also held into an application by the Borough Council of Southwark for the extension of powers already vested in the Corporation to other parishes of its district, the amount of money being confined to £16,000. In the course of the inquiry, Mr. Pelham remarked that Parliament had not laid down very clearly that it would allow a local authority to come in after a company was already established, to compete with the private company, and that he did not think Parliament had allowed such competion in a case where a company was already giving a sufficient supply for the consumer. It was contended on behalf of the electric lighting companies which opposed the application that they had carried out the statutory obligations which their orders imposed upon them, that they had spent large sums of money, and that no substantial complaints had been received as to their service. Mr. Pelham reserved his decision.

Madras.—By this time, we believe, the Madras Telegraph Office is lighted by electricity. Mr. W. D. Macgregor, the special officer in charge of the installation, has been for some time at work with the arrangements. An 18-H.P. motor drives three dynamos which are fixed on to one shaft. This motor, which works at 500 volts, 800 revolutions per minute, will be operated by current supplied by the Madras Electric Tramway Company. One dynamo of 300 volts, 41 amperes, charges the storage cells which will be used in working telegraph lines; the second of 220 volts, 41 amperes, charges the storage cells for driving the electric fans and lamps all over the building, while the third of 12 volts and 50 amperes charges the cells for the local circuits. Each of these systems has three sets of cells so arranged that one will be in use, another spare, while the third will be undergoing charging. During the day the fans will be worked direct from the dynamos, but at night the accumulators will be used to drive the fans and for illumination. There are 150 lamps distributed all over, each of 16 C.P., with 30 fans proportionately distributed, for the inspection of the various arrangements at night. When all the arrangements are completed the Madras Telegraph Office will be the best fitted one in India.

Morecambe.—The L.G.B. has sanctioned an additional loan of £5,000 for the extension of the electric lighting installation, including the erection of a sub-station at Bare, which it is estimated will cost £4,000.

Mundesley-on-Sea.—The R.D.C. has adopted the scheme of Messrs. Ridout & Co., electrical engineers, London. The cost of public lighting is not to exceed 3d. in the £, and the work is to be carried out within six months.

Lisbon.—Mr. Harrison, commercial attaché to his Majesty's legation at Lisbon, in a report received at the Foreign Office last month, states that at present electric light is hardly used at all in Lisbon, either in the streets or buildings, so that on its general introduction there will be a great demand for all kinds of electric fittings and apparatus. The large business done in other countries, Mr. Harrison thinks, makes it advisable for merchants to be prepared for this movement. Once in general use in the capital, he is of opinion that there can be no doubt of its introduction in most of the small towns and villages, and as it is a novelty in the country, there should be many openings for electrical engineers and experts.

Nelson.—Last week the formal inauguration took place of the new electricity station, which has been erected and equipped by the Corporation at a cost of £30,000, from the designs and under the superintendence of Mr. Fraser, the borough electrical engineer. The installation includes three engines and dynamos of 200 KW. each, the motive power being supplied by steam obtained from an adjoining refuse destructor. The dynamos will generate current for lighting purposes in Nelson and Brierfield, and for traction purposes for the Brierfield and Nelson lengths of the Burnley Corporation tramways, and a light railway from Nelson to Barrowfield and Colne.

Nuneaton.—A L.G.B. inquiry has been held into the application of the U.D.C. to borrow £5,000 for electric lighting purposes.

Peru.—The Peruvian Minister, Du Fomento, has ordered an inquiry to be made with a view to the eventual suppression of all overhead electric wires and supports. The present lines will be replaced by underground conductors.

Peterhead.—Messrs. Crompton & Co., Limited, have offered to erect an installation in the town for public and private lighting at their own expense, and to give the Corporation power to acquire the undertaking at certain dates on very reasonable terms. They offered to supply electricity for private lighting at 7d. per unit for the first hour, and 4d. thereafter, or 6d. flat; for power and heating, and for public street lighting, 3d. per unit.

South Shields.—On and after April 1st consumers of electric energy for lighting will have the option of taking it either at the present rate, viz., 7d. per unit for the first hour, and 2d. per unit for the remainder, or at a "flat" rate of 5d. per unit, provided they agree to take the light for 12 months.

Spain.—A company has just been formed at Alcala de Henares to establish and work an electric lighting station in the town. The plant will comprise a 60-H.P. gas engine, using producer gas.

Swansea.—In his report to the Electric Lighting and Tramways Committee of the Corporation, the engineer, Mr. Prussman, recently stated that the number of consumers on the books was 197; number of lamps, 22,696; consumers connected to the mains, 173. Applications have been received for three motors, with a total B.H.P. of 26. The condition of things generally is most encouraging. In addition to the proposed extensions already decided upon, at a cost of £20,000, there will probably have to be further extensions of the electricity works in 18 months' time.

Swindon.—The Corporation has fixed the price of energy for electric lighting at 5d. per unit as a flat rate, and 7d. per unit for 100 hours per quarter and 2d. per unit for subsequent units on the maximum demand system.

Swinton.—The Tramways and Electricity Committee of the Swinton and Pendlebury District Council has decided to borrow £10,000 for the establishment of a supply of electrical energy, purchased in bulk from some private company.

Taunton.—The Electric Lighting Committee's annual statement of accounts shows a credit balance of £325, of which £250 has been carried to the reserve fund, the balance to be carried forward.

ELECTRIC TRACTION NOTES.

Belfast.—The Corporation on Tuesday unanimously passed a resolution for the purchase of the tramways of the city on a fair and equitable basis.

Belgium.—The scheme for the construction of an electric railway between Brussels and Antwerp has been revived, the promoters on the present occasion being the well-known John Cockerill Company, of Seraing, which has submitted a definite proposal to the Government. The *Financier* says that the project takes the form of the building of an elevated railway on viaducts, 23 ft. from the ground level, with trains running at a speed of 84 miles an hour, at intervals of 10 minutes, and the journey between the two towns would be accomplished in from 20 to 25 minutes. It is estimated that the cost of construction would amount to £1,000,000, and the railway would be ready for traffic within two years.

Cardiff.—Mr. A. Ellis has presented an exhaustive and interesting report to the Tramways Committee as to the progress of the new works. He stated that the power station would be completed within the next fortnight or three weeks. He complained that unless the railway siding were completed at an early date there would be very great difficulty in getting up steam, for at present the whole of the coal had to be carted from the Taff Vale siding at Roath, and carried by hand to the fronts of the boilers; consequently they would be unable to use the mechanical stokers. Mr. Harpur, the borough engineer, explained that the siding was to be made by the T.V.R. Company, and the work need not take more than a week. As to the overhead equipment, Mr. Ellis reported that good progress was being made, though a considerable amount of time had been wasted during the month owing to the great number of alterations which had to be made to pipes and other obstructions under the pavement. The total number of bonds put in up to date was 9,837, at a cost of £160 19s. 7d. for labour, which worked out at 3·92d. per bond, or ·37d. less than shown in the previous report.

Gloucester.—The T.C. has resolved to purchase the undertaking of the City of Gloucester Tramways Company, Limited, for £26,000, and to promote a light railways order for new lines, the total cost of the scheme being something like £100,000.

Hertfordshire.—At Westminster last week the Light Railway Commissioners held an adjourned inquiry into applications for power to construct tramways in Hertfordshire. The County Council sought to make a line from the county boundary at Bushey to Watford, while the Watford and District Tramways Company, who have already obtained a Bill as affecting Watford itself, asked to be enabled to make extensions to Bushey in one direction and to Rickmansworth in the other. Mr. James Devonshire, director of the Metropolitan Electrical Tramway Company, stated that they had an agreement with the Herts County Council to lease from them the line if it were authorised. They had similar undertakings with the Middlesex County Council, and they contemplated that the Commissioners would see the desirability of the connecting link. The *Times* records that among the opponents of the Bill was the Rev. G. M. Hall, rector of Bushey, who said that tramways there were premature, and by the time the place grew ripe for them there would be better modes of locomotion—they would have something to fly with! The chairman said they would communicate their decision to the parties in a day or two.

Hove.—A report recommending the construction of 4·45 miles double and ¼-mile single track electric tramway was before the T.C. last week, together with a recommendation to acquire the Shoreham tramway, and work it electrically. Consideration of the report was adjourned.

Ilford.—The first "bonds" in connection with the Ilford electric tramways system have been put in by Councillors Ben Bailey, J.P., and Wilde, near Seven Kings' railway station. Good progress has been made with the work, and it is hoped that the trams will be running within the nine months specified for the completion of the contract. The contractors presented Mr. Bailey with a punch-bowl and Mr. Wilde with an inkstand.

Middleton.—Trial trips have been run by the B.E.T. Company on the tramways laid through the town to Chadderton at the Oldham boundary. The Board of Trade inspection is fixed for to-day.

Nottingham.—The fifth section of the electric tramways scheme—Sherwood Rise and Nottingham Road—has just been commenced. The line will be about a mile and a half in length. The Mapperley and Woodborough Road section is rapidly nearing completion, and will probably be opened for traffic by Whitsuntide.

Newcastle-on-Tyne.—The estimates of the Corporation have just been issued, and contain some interesting figures as to the cost of the tramways in that city. The items are:—Permanent way, £350,000; power station and car sheds, £176,139; machinery and equipment, £64,791; and the cars, £99,070. At a meeting of the Committee recently the chairman (Mr. W. Cail) said that the amount to be paid for redemption and interest amounted to above £41,000.

Oldham.—The electric trams from the Star Inn to Hollinwood, the section which was inspected a few days ago by Major Druitt, of the Board of Trade, commenced running for the public convenience last week end. It was originally intended to lay a double track from the Market Place to Mump's, but this particular length is being laid with a single line by reason of the roadway not being wide enough to allow a distance of 9 ft. 6 in. between the rails and the footpath, and the tradesmen's objections to a double track. The Tramways Committee have decided to take up the double track they have laid in St. Domingo Street and re-lay a single line. This is the result of Chancery Court proceedings instituted by shopkeepers and property owners in that thoroughfare against the laying of a double track. The Oldham Corporation Bill enables the Corporation to lay double tracks where the distance between the outside rail and the kerbstone is not less than 9 ft. 6 in., or where the consent of the frontagers has been obtained. The consent of the owners was not obtained in this case before the construction of the track was begun. Since the weather has been favourable for tramway construction, considerable progress has been made with the various sections.

Redruth.—The Urban Electric Supply Company, Limited, has commenced to lay the rails for the trams between Redruth and Camborne.

Perth (W.A.).—In our issue of the 7th inst., page 386, we reprinted from the *British Australasian* a statement relating to this company's concessions in Fremantle. We have been asked by the Electric Supply Company of Western Australia, Limited, of Liverpool, to publish the following copy of a letter which they have sent to the editor of that paper:—

Dear Sir,—The attention of my directors has been called to an extract taken from your paper and reprinted in the ELECTRICAL REVIEW of the 7th inst., to the effect that this company's concessions for the lighting and tramways of the City of Fremantle, Western Australia, have been cancelled. As this statement is at variance with the latest information received from our agents, we shall feel obliged if you will give us your authority for the statements made.

Yours truly,
G. SAILS, *Secretary.*

Richmond (Surrey).—An agreement has been sealed between the Corporation and the London United Tramways, Limited, the general provisions being:—

(1) No overhead trolleys in Kew Road. (2) Statutory widths of roadways without diminishing the footpaths; new paths to be at least 7 ft. 6 in. (3) Track not to be commenced until all widenings are completed. (4) Cheap fares and workmen's cars. No further promotions without Council's consent, and no line across Kew Bridge except at the request of the Corporation. (5) Trees not to be interfered with except by agreement. (6) Reasonable stopping places. (7) The company not to erect a generating station nor to supply current within the borough. (8) Protection of existing cables, water mains, &c. (9) Gongs to be approved, and sounded according to regulations to be made by the Corporation. (10) The Kew Road service not to be more frequent than once in three minutes, and the cars to be smaller than those on the Chiswick line. (11) Annual wayleave, £1,250, including the extension of the lease of the Kew Road horse tramway. (12) Track to be wood-paved and the remainder of the roadway to be wood-paved by arrangement. The company to wood-pave the whole road opposite places of worship. (13) 30 years' purchase clause under the Tramways Acts.

The company have also made an offer to give £20,000 towards the cost of securing a right of way, *viâ* the Quadrant, Eton Street, Paradise Road, Ormond Road and Red Lion Street, the further consideration of which has been adjourned.

Rochester.—The Tramways Committee of the T.C. have discussed a scheme for the laying of tramways in the city and neighbourhood, and have directed their manager to prepare plans of routes upon an ordnance sheet, so that the matter may be finally discussed.

Salford.—The differences between Salford and Eccles in connection with the construction by the former authority of some six miles of tramways in Eccles have been satisfactorily arranged, and the agreement is to be submitted for the approval of the Board of Trade. When the two boroughs have their respective new systems connected, Salford will take a long lease of the Eccles tramways, supplying the necessary electricity to the new cars in the meantime.

Spain.—A narrow-gauge electric tramway is about to be constructed between Coruna and Santiago. The water-power of the River Tambre is to be utilised in the generation of the necessary electrical energy.

Spen Valley.—The *Yorkshire Observer* says that the Heavy Woollen District Electric Tramway Company, whose lines will run from Cleckheaton down the Spen Valley and over the hill at Staincliff to Dewsbury, Thornhill, over Savile Town, are about to erect car stations and offices at Heckmondwike and Savile Town.

Sunderland.—There was a long debate at the meeting of the T.C. on the 12th inst. on the question as to whether the electrical trams should be run down the High Street into the east end, the vicinity of the docks. The Committee having charge of the tramways recommended, as we stated last week, that, in consequence of the great cost involved in the scheme, the route should not be carried out. The Council refused to sanction the construction of the route, all the opponents to which emphasised the excessive cost of it.

Torquay.—The T.C. held a special meeting on 10th inst. to receive a report from the Electric Lighting Committee bearing on the question of tramways. The Electric Lighting Committee recommended: (1) That before making any recommendation as to the best system to be adopted, they required further time to consider the question, with power to inspect any system; (2) that the question of routes be deferred for further consideration; and (3) that the Council defer the question as to whether the Corporation should apply for a provisional order themselves, or negotiate with a company or companies. The report was adopted.

Wallasey.—Two out of the three routes of the new Wallasey electric tramways, between Seacombe Ferry and New Brighton Ferry, have been opened for traffic during the present week. The third and longer route, through Liscard village, will be opened at Easter.

West Australia.—A special dispatch from Perth to the *Financial Times* says that it is now considered certain that the Boulder Tramway Concession will be granted to the Kalgoorlie Electric Tramways, a change of feeling having been brought about by the extraordinary rapidity with which the Kalgoorlie tramways are being built, rendering it certain that unless Boulder is similarly provided with a tramway the people will move to Kalgoorlie, where, at a meeting of ratepayers, Mr. Stoneham announced that cars would be running on May 1st.

West Bromwich.—The Highways Committee's report, to which we referred last week, has been adopted by the Council.

Underground Railways.—Last week a debate on the injury caused to property by underground railways took place in the House of Lords on the motion of the Earl of Camperdown, "that it is desirable whether by instructions to the Select Committees on these Bills or otherwise, to provide that the liability of railway companies at common law for such damage, shall not be impaired by the passing of any such Act." The Earl of Morley, in the course of the debate, said that he did not think it desirable that a limit should be placed upon the discretion of the Private Bill Committee, and believed that the difficulty would be largely met if the committee were empowered to introduce into private Bills of this kind such clauses as the Board of Trade should recommend, with the object of minimising and rendering almost impossible the evils of which the noble earl complained. He was as anxious as the noble earl to prevent or obviate these evils, but he deprecated the idea that they should alter the whole law of the land in relation to railways by applying to these underground railways a different law to that which they applied to railways generally. Such an alteration of the law would check enterprise altogether and prevent many useful undertakings from being carried out. The Earl of Camperdown said the question was one which Parliament ought to deal with, and which it should not delegate to any other body, however eminent. He did not, however, propose to press the motion to a division, but would be content with the discussion which had taken place.

ELECTROMOBILE NOTES.

Storage Batteries.—Only those electrical engineers and electric vehicle manufacturers who have had to solve the problem of providing a storage battery for use in road vehicles on common roads realise the great strides in such batteries that have been made, and the many improvements, principally in details, introduced by many inventors and patentees during the last six years, resulting in batteries of (*a*) very great output for weight; (*b*) capable of standing 100 per cent. excess of charge and discharge; (*c*) plates protected against disruption and attrition; (*d*) the completed cells mechanically strong to stand the incessant jolting and shocks on a road vehicle; (*e*) acid-tight cases with ventilating valves; (*f*) flexible and tough connections from cell to cell and to the controller—all adapted to make the batteries suitable for the rough usage, stopping and starting the vehicle, often all but short-circuiting, they meet with. It must be a source of great satisfaction to those who have pioneered these improvements and find the results satisfactory. We trust it may be to their profit also. Reliable storage batteries can now be obtained for use in electric road cars, giving the effective horse-power hour for 56 lbs. of cells, as against 168 lbs. and more required six years ago, and even now listed by those makers who have not made a speciality of this type of cell. The advance made in reduction of weight, combined with greater durability, has made the electric road car a practical and economical means of conveyance and transit, and places the manufacture of such vehicles on a sound commercial basis. Manufacturers of petrol and steam motor cars, having their interests in view, appreciate this apparently more readily than the electrical engineer, and in America, France (De Dion Bouton Company), Germany, Spain, and Austria, electric automobiles are being made as a commercial and readily-saleable article. We are not aware of a single electric road car manufactory in this country, at least not one turning out cars for sale in any quantity, and able to meet the demand. Most of the electric cars in use in this country are imported from America, Germany, and France.

The Brush Light (Petrol) Car.—The Brush Electrical Engineering Company have given their attention to constructing petrol motor cars, and these can be seen at their new showrooms, 66, Great Russell Street, London, W.C. We have lately heard of a British-German firm who started some three years ago to make automobiles, but at that time they considered it better to make petrol motor cars, and did so; now, however, they have decided it is time to take up the manufacture of electric motor cars, and are doing so.

Brussels.—In the Automobile Exhibition opened in Brussels last Saturday, Messrs. M. J. Lefert, of Ghent, and M. O. De Ruyter, Demessine of Brussels, are exhibiting electrical vehicles. No English vehicles are to be seen.

Motor Car Imports and Exports.—The Board of Trade gives 213 vehicles as imported into this country during February last, valued at £47,759. Exports from this country for the same month were valued at £6,379. For January and February the imports were valued at £89,688, whilst the British exports were £17,561.

America.—The Fischer Motor Vehicle Company have introduced a combined gasoline and electric omnibus. The system consists of a gasoline engine and dynamo, one motor for each rear wheel, and a small storage battery with a controller. The *Scientific American* for March has a full description. The omnibus is made to carry 18 passengers. The power equipment consists of a 10-H.P. 3-cylinder 4-cycle gasoline engine, running 600 revolutions per minute. Directly on the engine shaft is placed the armature of a 5-KW. 110-volt dynamo. The motors are of special twin type, built together, of 5 H.P. each, and will stand an overload of 100 per cent. for a short time. The controller is of the series-parallel type, with five forward speeds of from 2½ to 10 miles per hour, and two reverse speeds of 2½ and 5 miles per hour, all controlled from one lever. The batteries consist of 50 cells, of 90 ampere-hour capacity. The front wheels are 38 in.

in diameter, and the rear 46, all equipped with 4-in. Calumet solid rubber tires. The increase in the size of the wheels over former electric and other motor-omnibuses tried in this country is a very noticeable feature. The gasoline engine is not connected to the wheels, but is used to drive the dynamo only, and at a practically even speed and constant output. Under normal conditions, such as running on the level, the current goes directly from the dynamo, through the controller, to the motors; but when running down inclines, or slowing up, the current is automatically taken up by the batteries; on the other hand, when extra power is required in ascending steep grades, or starting heavy loads, the battery furnishes the deficiency. The dynamo is used as a motor to start the engine. In a test of this combined omnibus recently made, the results are given as follows:—Total mileage in one day, 54 miles, the engine using 12½ gallons of gasoline costing 9 cents per gallon, making the cost of fuel a fraction over 2 cents (1d.) per mile. There are many interesting features in this system, and we know of several engineers who are making experimental combination petrol and electric motor cars.

TELEGRAPH AND TELEPHONE NOTES.

Cardiff Telephones.—Further information with reference to municipal telephones was placed before the Cardiff Parliamentary Committee on Friday last, and after discussion it was resolved to adjourn the further consideration of the subject until the Town Clerk was able to obtain further information.

Lagos.—The annual report of the Governor states that inland telegraphic communication between Jebba in Northern Nigeria, and the prinicipal out-stations in the colony (Lagos), was maintained during the year by the Government at a cost of £1,350. The rate charged is 6d. for 12 words.

Natal Telegraphs.—In the *Natal Government Gazette* it is stated that the estimate of the amount required to defray the expenses of works under Loans Telegraph Department, in the year ending June 30th, 1903, is £26,164. Of this amount, the sum of £7,584 will be required for the new through telegraph line, Durban to Howick, skirting the railway.

Reductions of Telegraph Rates.—The Eastern Extention Australasia and China Telegraph Company announces that in view of the recent substantial reduction of tariff for telegrams transmitted between Europe and British India, it has arranged for the following reduction of rates to be brought into force from the 1st prox. for telegrams exchanged between Europe on the one side and the Straits Settlements and Netherlands East Indies on the oth r side:—For Straits Settlements, from 4s. 6d. per word to 3s. 6d. per word; for Java, from 5s. per word to 4s. per word; for Sumatra and other islands, from 5s. 5d. per word to 4s. 5d. per word.

Telegraph Rates to India.—In the House of Commons on 14th inst., Mr. Henniker Heaton asked the Secretary of State for India whether he had made any fresh agreement with the Eastern Telegraph Company or with the Indo-European Telegraph Company in connection with the recent reduction of telegraph rates to India; whether he would give an assurance that no agreement or re-arrangement of agreements with the Indo-European or Eastern Telegraph Companies would be made until after the House of Commons had had an opportunity of examining and discussing the full and final report of the departmental committee. In reply, Lord G. Hamilton said that no fresh agreement had been entered into with the Eastern and Indo-European Telegraph Companies in connection with the recent reduction of rates to India. It was not proposed to interrupt or delay the negotiations now in progress with regard to a date for the determination of the Joint Purse Agreement and the Australian Message Fund.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	March 11.
Alexandria-Laruaca	Jan. 19, 1902 ..	..
Perim-Obock	Feb. 26, 1902 ..	..
Cayenne-Pinheiro	March 8, 1902 ..	..
Carcavellos-Ponta Delgada	March 10, 1902 ..	March 15.
Jamaica-Colon	March 13, 1902 ..	..
Zanzibar-Mombassa	March 13, 1902 ..	..
Assab-Massana	March 17, 1902 ..	..
Landlines:—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
Guanta-Barcelona	March 17, 1902 ..	..

Wireless Telegraphy.—It is stated that the director of the chief post and telegraph office at Odessa has authorised the installation of wireless telegraphy apparatus for experimental purposes between Kherson and Golaja Pristan, a distance of 10 miles, in order that the officials may become acquainted with all the details of the system.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barcelona.—April 7th. The Port and Docks Board of Barcelona will on this date consider tenders for supply and installation of machinery, geared by electricity for the loading and unloading of merchandise, and the establishment of the necessary conduits, as well as the installation of electric light.

Bedford.—April 3rd. 28 30-kw. alternating current transformers for the Corporation. See "Official Notices" to-day.

Brighton.—March 24th. Telephone cables, conduits, poles, instruments, wires, batteries, switchboards and various other materials for Corporation telephone system. See "Official Notices" February 28th.

Devonport.—April 16th. Permanent way, bonding, &c., for over three miles of track for the Corporation. See "Official Notices" March 14th.

Edinburgh.—March 31st. Arc lamp carbons, cast-iron pipes, also road box frames, covers, &c. See "Official Notices" March 14th.

Hackney.—April 9th. Three water-tube boilers, water softener, &c., for the electricity works. See "Official Notices" February 28th.

Halifax.—March 24th. Water-tube boilers, superheaters, 200-kw. rotary converters, 75-kw. transformers, and high tension switchboard for the Corporation. See "Official Notices" March 14th.

Ilford.—March 24th. Cars, trucks, motors and equipments. See "Official Notices" February 21st.

Ilford.—March 27th. U.D.C. wants tenders for overhead line equipment, poles, feeder cables, &c. See "Official Notices" March 7th.

Maidenhead.—April 4th. "Easy wiring" proposals are wanted by the E.L. Committee. See "Official Notices" to-day.

Manchester.—March 27th. Steam and other piping and tanks for Stuart Street generating station for the Corporation. See "Official Notices" March 14th.

Middleton.—March 26th. Tramway feeders and pilots, cast-iron pipes and extensions to lighting distributors for the Corporation. See "Official Notices" to-day.

Oldham.—March 25th. Piping, pumps, tools, &c., for the Greenhill electricity station. See "Official Notices" February 28th.

Penang.—April 28th. Boilers, condenser, pumps, pipes, steam dynamos and balancer booster, switchboards, batteries, cables, junction boxes, arc and glow lamps, posts and accessories, for the commissioners of George Town. See our "Official Notices" March 14th.

Plymouth.—March 25th. Electricity meters, cables, and transformers. See "Official Notices" March 7th.

Plymouth.—March 25th. Lancashire boilers and stokers, piping, condensers, valves, &c. See "Official Notices" March 7th.

Rathmines.—May 1st. 300-kw. steam dynamo, switchboard and mains. See "Official Notices" to-day.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See Electrical Review, January 10th.

St. Petersburg.—March 25th. The Executive Board of the municipality is wanting tenders for the installation of a temporary telephone station for 900 subscribers. Full particulars were given in our advertisement pages last week of the various apparatus and instruments and cables required.

Salford.—March 22nd. Electric motors up to 3 h.p., ditto, from 4 to 15 h.p., also starting switches and resistances, for the Corporation motor hiring scheme. See "Official Notices" March 7th.

Shipley.—April 2nd. Tenders are invited for an electric light installation at the Central Schools. See "Official Notices" to-day.

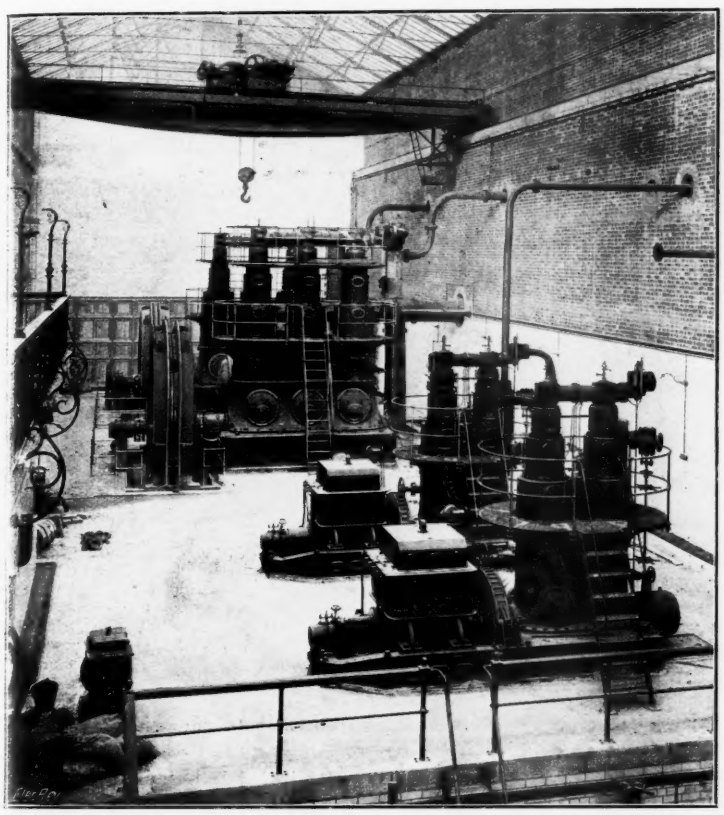
Southend.—April 2nd. Electric wiring propositions are wanted by the Corporation. See "Official Notices" March 14th.

Spain.—March 29th. The *Board of Trade Journal* says that for the third time tenders are being called for the installation and working for 15 years of the electric light in the "Carcel Modelo," Madrid, at the upset price of 40,000 pesetas, or about £1,164 per annum, payable in monthly instalments. A provisional deposit of 2,000 pesetas, or about £58, is required to qualify any tender. The number of lamps and other particulars may be learnt upon application at the Secretariat of the Prison Committee, situated in the "Prisión Celular," Madrid.

(*Continued on page* 477.)

BRISTOL ELECTRICITY WORKS EXTENSIONS.

The Corporation of Bristol was one of the earliest to obtain a provisional electric lighting order, this being granted by the Board of Trade in 1883, the year after the passing of the Electric Lighting Act. Mr. (now Sir) W. H. Preece was appointed consulting engineer, but acting upon his advice the Corporation deferred further action for several years—electricity being at that time, we presume, in arms. However, in 1891, Mr. Preece drew up a scheme for the supply of 20,000 8-c.p. lamps and 100 arc lamps, estimated to cost £66,000, and the erection of a generating station was commenced on a site at Temple Back; in the following year Mr. H. Faraday Proctor was appointed city electrical engineer, and proceeded with the work of laying down the plant and mains. Supply was begun in 1893, simultaneously with the opening of the Bristol Exhibition, and by the end of the same year there were 8,000 lamps connected. Large extensions were carried out in 1894, and again in 1896; the additional auxiliary machinery installed in the latter year was arranged for electric driving, a proceeding which attracted much attention. Additions to the plant took place every year, and in 1900 a direct current supply for motive power purposes was begun. By this time the resources of the original site were practically exhausted, and as it was impossible to obtain space for extensions at a reasonable cost, it was resolved to erect new works capable of meeting all requirements for many years to come.



View of Engine Room, Avonbank.

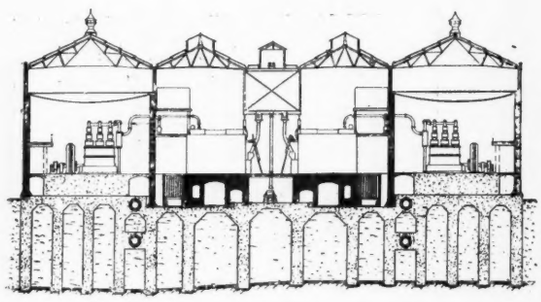
For this purpose, Mr. Proctor, with the assistance of his staff, drew out a complete scheme and designed the new station. The site adopted by the Electricity Committee at Avonbank, on the Feeder Road, is bounded by a canal and a colliery—apparently ideal neighbours! A branch line of the Great Western Railway Company also adjoins the site, which covers 10 acres, and is within a reasonable distance of the area to be supplied.

The excavations were commenced in November, 1900, and the foundations were finished in five months. No time was lost in erecting the buildings and plant, and so rapidly was the work pushed forward, that in December, 1901, the boilers were got under steam. The official inauguration of the new works took place on the 19th of last month.

The first instalment of the works has been erected near the north-west corner of the site, and the line forming the centre of the ultimate scheme passes through the middle of the existing stoking space; in other words, one complete section of engine room and boiler house has been erected, which will at a later date be repeated on the east side of the stoking space, the latter being common to the existing and future portions of the works. The present portion forms only about one thirty-third of the ultimate scheme as plotted out for this site.

Coal-handling Plant on Canal Bank.

On taking "borings" of the site it was found that the subsoil consisted of made ground, peat, clay, and gravel, under which was found the hard red marl, this being practically level for the whole of the area now built upon. The foundations are formed of concrete walls of thicknesses varying from 4 ft. 6 in. upwards, running parallel with the main walls of the building; it was found that the subsoil was sometimes dry and sometimes wet, even at a considerable depth, so that the conditions were quite unsuitable for timber pile foundations. On the top of the concrete walls there is a bed of concrete of thickness varying according to the weight that is to be carried.



Section of Avonbank Works (as Completed.)

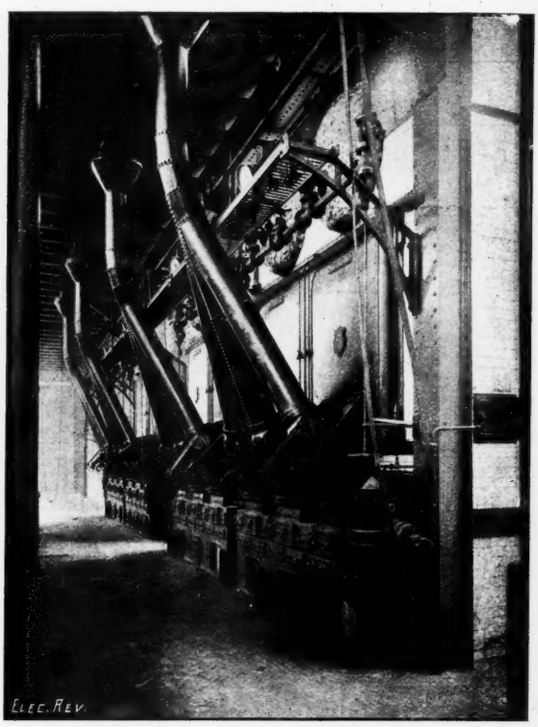
The building has been arranged wholly with a view to utility. Since the inside of the engine room wall is required for the fixing of switchboards, no windows have been placed therein; indeed, these are not required, as the whole of the roof is formed of glass.

A 15-ton electrically-driven single-motor travelling crane is provided in the engine room.

A dock has been formed on the Feeder canal to allow of coal barges lying alongside without interfering with other vessels. The coal discharging plant consists of an electrically-driven winch working a Hone's grab at the water's edge; this lifts the coal from the barge, and passes it through an automatic weighing machine into a truck, which runs by gravitation down an incline erected high above the roadway. The weight of the loaded truck is utilised to raise a heavy counterweight; when the truck has reached its journey's end, its sides automatically open, the coal falls into the elevator pit, and the empty truck is returned to the riverside by the counterweight. From the elevator pit an endless chain of buckets, driven by an electric motor and gear placed in the conveyer house above the coal bunkers, carries the coal to the top of the building, and over the whole length of the bunkers, into any part of which the coal can be emptied automatically; passing down the rear end of the block, the buckets return on a lower level by way of the ash tunnel. From the coal bunkers overhead long shoots are arranged, by which the coal can be discharged into the buckets at the lower level, and can be taken by them up again to another part of the bunkers; thus it is possible to move the coal from one position in the bunkers to any other where it may be required, a provision not usually arranged for, but obviously of considerable advantage. From the bottom of the coal bunkers shoots also run to the different coal hoppers fitted to the mechanical stokers. These shoots are so arranged that the coal can be measured as it is used.

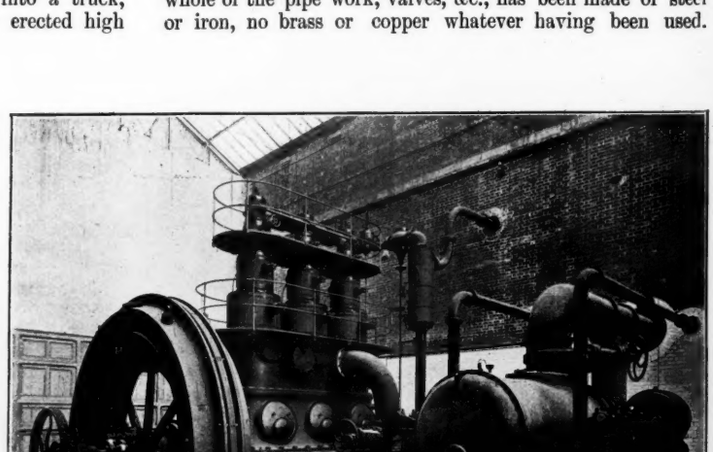
The stokers are of Meldrum's "Koker" type, and are worked in conjunction with induced draught. The ash passes over the back of the fire bars, down shoots into the ash tunnel below, whence it is wheeled away.

At the present time four Babcock water-tube boilers have been installed, each of which is capable of evaporating 1,400



Boiler House at Avonbank.

gallons per hour. The steam pressure at which these boilers are worked is 200 lbs.; they are fitted with superheaters, and owing to the high temperature of the steam the whole of the pipe work, valves, &c., has been made of steel or iron, no brass or copper whatever having been used.

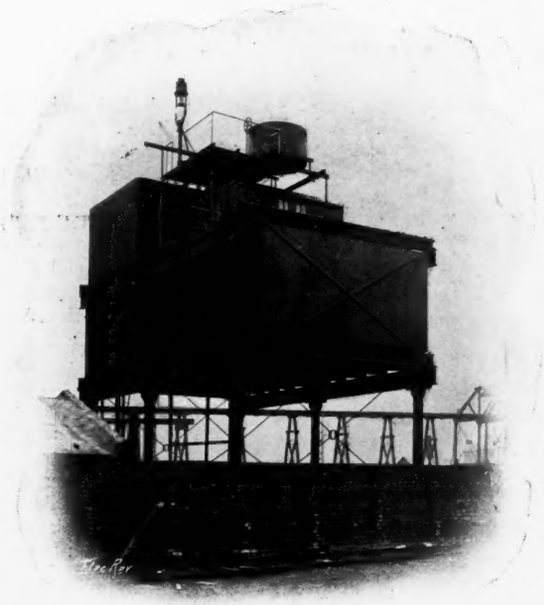


Steam-Alternator and Condensing Plant.

Green's economisers are placed in the flues at the back of the boilers.

The chimney stack is of mild steel, 9 ft. in diameter, 70 ft. high; at the base there are two fans, each 7 ft. 6 in.

diameter, 25 in. in width, driven by Bumsted & Chandler's two-crank high-speed engines of 75 B.H.P., which fans draw the gases from the main flue and force them up the chimney.



Water-Softening Plant.

The fan engines are fitted with automatic governors, so arranged that an increase in the steam pressure at the boilers will act upon the governors and decrease the speed of the engines, thereby lessening the intensity of the induced draught until the boiler pressure has again fallen to the normal. The automatic control is obtained by a governor, invented by Mr. Chandler, which acts on the principle of the Bourdon pressure gauge, and appears to be very sensitive.

The fans have been tested for a capacity of 97,000 cub. ft. of air each per minute, at 60° F., and a water gauge pressure of 2½ in., at the low speed of 255 revolutions per minute.

The induced draught plant, including the chimney stack itself, was supplied by Messrs. Bumsted & Chandler, of Hednesford.

In the boiler house, between the range of boilers and the chimney, there is a pump house containing steam pumps for feeding the boilers, and water meters, through which all the water used is passed; also a steam engine and an electric motor, either of which may be used for driving the stoking gear.

The pumps are of Messrs. G. & J. Weir's tandem-compound type, the pumps being 10 in. diameter by 21 in. stroke. The high pressure and low pressure steam cylinders are arranged on the vertical tandem system, with a single steam valve of the Weir type for the two cylinders. The pumps are of cast-iron, fitted with bronze liners and bronze buckets. The high pressure cylinder is supported on columns, entirely clear of the low pressure cylinder, so that no leakage can pass from one cylinder to the other.

This firm has also supplied two general service pumps, 9 in. diameter × 18 in. stroke, each capable of delivering 10,000 gallons of water per hour against a 45 ft. head.

At the corner of the land near to the north end of the buildings are placed the water softeners, supplied by Messrs. Doulton & Co., of Lambeth. They consist of cast-iron tanks, placed at a high level, in which suitable chemicals for softening the feed water are mixed. The water is afterwards delivered into settling tanks, from which the feed pumps draw their supply.

In the engine room, which is 150 ft. long × 47 ft. wide, and 40 ft. high to the springing of the roof, there are at present placed two 745-KW. steam alternators, each capable of an emergency load of 920 KW. There are also two 165-KW. steam dynamos, intended for supplying energy to the numerous motors used for driving auxiliary plant in the present instalment and future extension of the works.

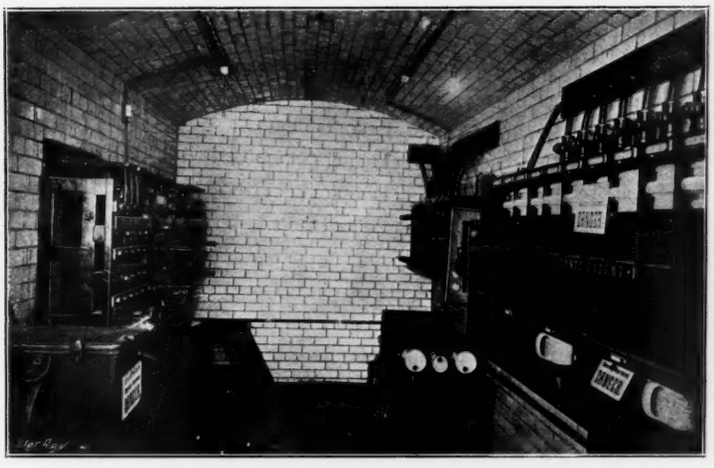
All the engines are of the Willans standard type, the larger having three and the smaller two cranks.

Each of the larger engines is direct coupled to a Siemens "copper-type" alternator, running at a speed of 224 revolutions per minute, and generating electricity at a pressure of about 2,000 volts, 93 cycles per second. The exciters for the alternators are also of Messrs. Siemens Bros.' make.

The smaller engines are direct-coupled to Siemens two-pole compound-wound dynamos, generating direct current at a pressure of 500 volts.

The condenser, supplied by Messrs. W. H. Allen, Son & Co., is of the surface type, with a total cooling surface of 4,000 sq. ft. This condenser is capable of dealing with 45,000 lbs. of steam per hour, with cooling water at 60° F. Two electrically-driven three-throw air pumps are provided, each having a diameter of 10 in. × 10 in. stroke, and each is capable of dealing with 22,500 lbs. of steam per hour when running at a speed of 170 revolutions per minute. These pumps are constructed on the Edwards principle, and are driven through connecting rods from a three-throw crankshaft, which is coupled direct to an electric motor of Messrs. Siemens' shunt-wound type. The circulating water for the condenser is supplied by two centrifugal pumps. One of these is of Messrs. Allen's "Conqueror" centrifugal type, having suction and discharge branches 12 in. diameter, and is capable of delivering 2,500 gallons of water per minute. This pump is coupled direct to an electric motor. The other pump is driven by a Bumsted and Chandler steam engine, similar to those employed for driving the fans.

The circulating pumps are placed in the pump pit at the extreme end of the existing portion of the engine room. In the middle of this pit there is a cold well, from which the water is drawn, this cold well being connected with the Feeder by means of a culvert 3 ft. in diameter; a return culvert has also been run, through which the water is all returned to the Feeder after it has been passed through the condensers. Provision is made in the existing pit for increasing the present pumping capacity three-fold. In the pit are also placed the service steam pumps, for delivering water from the cold well to the water-storage tanks placed at a high level in the boiler house, and to the water-softening plant.



Sub-Station at Whiteladies' Road.

From the pump pit, which is 12 ft. below the level of the engine room floor, access is gained to the exhaust pipe trench, which runs throughout the length of the engine room, and in

which there is ample room for the inspection or overhauling and repairing of the pipes.

On the other side of the engine room, and in a corresponding position under the floor, there is a similar trench for electric cables, which at one end will be extended to the Feeder Road, and thence either to the Temple Back works or to different parts of the city, and at the other will be carried up to the switchboard gallery, which has been placed against the outer side wall of the engine room.

Engine Room at Temple-Back.

The switchboard gallery is at a height of 12 ft. above the engine room floor, the space beneath being used for the machine resistances and other apparatus. The switchboards are of the Ferranti type, and are built into the wall.

Each machine and circuit panel consists of an oil-break fuse, with duplicate contacts, a high pressure spring "oil-break" switch and high pressure ammeter.

The same type of switchboard is being installed by degrees at Temple Back, to take the place of the older form of switchboard.

From the switchboard connections are made by means of trunk mains with the plant at Temple Back, it being the intention to run the whole of the plant, for the time being at any rate, in parallel, the energy generated at the Avonbank works being transmitted by means of these mains to Temple Back works for distribution over the city. The mains at present laid are three in number—two-conductor, concentric, paper insulated, of Messrs. Siemens Bros.' make.

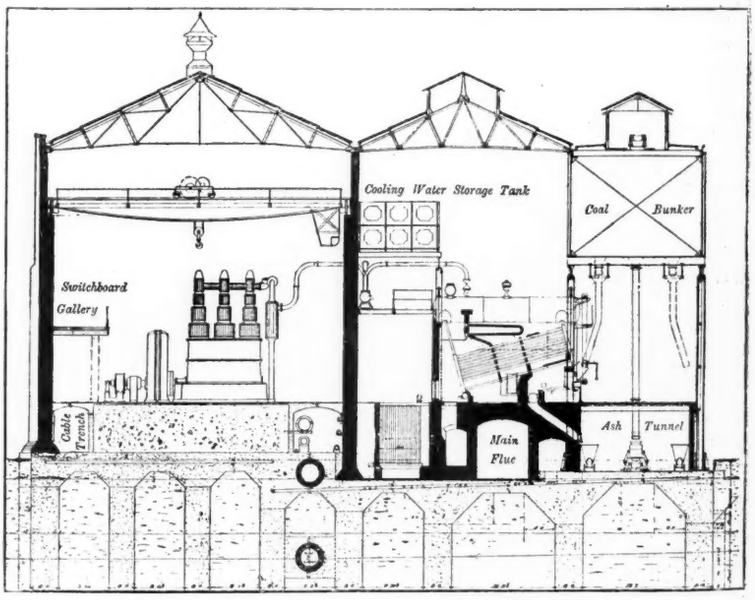
The distribution of energy is carried out on the three following systems:—High pressure alternating current at 2,000 volts; direct current at 600 volts for arc lighting; and direct current on the three-wire system at 250 or 500 volts.

The high pressure alternating current system was adopted on account of the very large area over which the energy has to be supplied.

The current is taken from the central station direct to distributing sub-stations at various central points, and is there transformed from 2,000 volts to 105 or 210 volts, at which pressure it is delivered to the consumers.

The sub-station, situated under the roadway at the junction of Whiteladies Road with Queen's Road, of which an illustration is given, is used as the distributing centre for the whole of Clifton and Redland. Sub-high pressure cables are taken therefrom to all the different sub-stations in the before mentioned neighbourhoods, all the necessary fuses and other safety appliances required for the controlling of these feeders being contained in this distributing station. The trunk feeder cables for the Clifton and Redland Street arc lighting circuits are similarly treated in this sub-station. There are in all at the present time 55 sub-stations, the dimensions of the smallest standard size of sub-station being 10 ft. long, 6 ft. 6 in. wide, and 6 ft. 6 in. high.

The cables used for feeding the sub-stations with high-pressure current are two-conductor concentric cables, insulated with impregnated fibre or paper, lead-covered and armoured. These cables are laid direct in the ground, and covered over with bricks.



Cross-Section of Avonbank Works (as at Present).

The low pressure cables are made up with three concentric conductors similarly insulated and armoured.

The whole of the street arc lighting is arranged on the multiple series system, 12 lamps being placed in each

circuit. The first 96 street arc lamps erected in Bristol were on this system. The arc lamps are all of the Brockie-Pell double type, the older lamps having top and bottom carbons of the same diameter.

Since numerous applications were received for electricity for driving machinery in different parts of the City, it was deemed advisable to inaugurate a supply of direct current for such purposes, since direct current motors are more suitable for driving some classes of machinery than those supplied with alternating current. Mains for supplying this class of energy have been laid in the principal manufacturing districts in the central portions of the city, and are being extended to some of the outlying districts as the demand arises.

The number of lamps added during the last financial year was the greatest recorded in the history of the undertaking, amounting to 21,799, and the rate has been maintained during the current year. Electric radiators have also been freely used, but the greatest progress is shown by the motor load, electrical energy for this purpose being supplied at a very low rate—1½d. per unit, subject to a discount up to 20 per cent. according to quantity. Before this rate was adopted, in 1900, the motor load was 111 H.P.; in the following year it rose to 377 H.P., and in February this year it was 719, while applications are in hand for 600 H.P. in addition.

Energy used for lighting, between midnight and one hour before sunset, is charged for at the rate of 3⅓d. per unit; at other times the charge is 5d. per unit, and both rates are subject to a discount on a sliding scale up to 30 per cent. The total lamp connection last month was 122,293 8-C.P. lamps, and 310 public arc lamps. Including also the motors, the total connections are equivalent to 140,172 8-C.P. lamps, and the capacity of the plant is 164,660 8-C.P., or 4,922 KW. The units sold in the current year up to last month amounted to over 2 millions. It will be seen, therefore, that the undertaking is in a highly prosperous condition, a fact which reflects great credit upon the city electrical engineer, Mr. H. Faraday Proctor, and upon his staff, chief of whom are the deputy city electrical engineer, Mr. H. H. Conzens, and the station superintendent, Mr. J. H. Bolam. No article on Bristol electricity department would be complete without reference to Alderman George Pearson, the popular chairman of the Electrical Committee, who has stood by the department through thick and thin, and is in no small degree responsible for its success.

CONTRACTS OPEN.

(*Continued from page* 472.)

Southampton.—March 26th. Trolley wire, poles, rail bonds, &c., for the Corporation tramways. See "Official Notices" March 14th.

Southampton.—April 5th. Boilers, mains, conduits, economiser, crane, and machine tools for the Electricity Department. See "Official Notices" to-day.

Southend.—April 3rd. 50 arc lamp columns for the Corporation. See "Official Notices" to-day.

Spain.—April 1st. The Spanish Post and Telegraph authorities in Madrid are inviting tenders until April 1st for the supply of 136 tons of iron wire 4 mm. diameter, and 5 tons 5 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas 10, Madrid.

Spain.—April 3rd. The Spanish Post and Telegraph authorities are inviting tenders until April 3rd for the supply of 15 tons of copper wire. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Stoke-upon-Trent.—March 26th. Engine and dynamo, electric motor, &c., for the Guardians. See our "Official Notices" March 14th.

Sunderland.—March 26th. India-rubber cable and cast-iron pipes for electric light department. See "Official Notices" March 14th.

Sydney.—May 7th. Messrs. Preece & Cardew, on behalf of the Municipal Council, invite tenders for equipment of electricity works and sub-stations. Water-tube boilers, three-phase steam alternators, battery, motor-generators, static transformers, switchboards, &c. See "Official Notices" to-day.

Warrington.—April 9th. Steel rails and permanent way work, also overhead equipment for Corporation tramways. See "Official Notices" March 14th.

Watford.—March 27th. "Free" wiring proposals are invited by the U.D.C. See "Official Notices" to-day.

CLOSED.

Aberdeen.—Tenders have been accepted as follows for the electrical equipment of the Rosemount section of the tramways:—

B.I.W. Co., overhead work	£819
Anchor Cable Company, cables	1,412
British Electric Car Company, 12 cars	6,710

Bradford.—The Corporation has accepted the offer of the General Electric Company, Limited, to supply 10,000 16-C.P. 230 volts B.C. incandescent lamps for the sum of £447 18s. 4d. The work of building the new generating station in Valley Road is being pushed on night and day, and the Corporation has accepted the offer of Messrs. Babcock & Wilcox, Limited, to supply four water-tube boilers complete, with superheaters, stokers, and overhead gangway, for this new station for the sum of £6,930.

Brighton.—Messrs. Witting Bros., Electrical Engineers and Contractors, Limited, have secured the order for 10 complete motor cars, each consisting of a Milnes car body of latest type, mounted upon a Brush truck, the electrical equipments being of Witting Bros.' standard pattern throughout.

King's Lynn.—The T.C. have accepted the tender of Messrs. H & T. Danks, Netherton, Dudley, for a new Lancashire boiler, connecting pipes, &c, at £782 10s.

Kingston-upon-Thames.—The T.C. on Tuesday accepted the lowest of the following tenders for the supply of one mile of each of the low pressure cables specified:—

	'1 (per mile).	'2 (per mile).
St. Helens Cable Company	£312 0 0	£530 0 0
W. T. Glover & Co.	295 0 0	493 0 0
Siemens Bros.	290 0 0	470 0 0
Johnson & Phillips	282 17 6	458 17 6
British Insulated Wire Company	255 0 0	425 0 0
	267 0 0	440 0 0
Henley's Telegraph Co. (accepted)	252 0 0	408 0 0

Liverpool.—The City Council have accepted tenders for supplies of articles required in the electric supply department for the year ending March 31st, 1903, as follows:—For insulated cables and wires, the Telegraph Manufacturing Company, Limited; the St. Helens Cable Company, Limited; Messrs. W. T. Glover and Company, Limited; incandescent electric lamps (English make), Edison & Swan United Electric Light Company, Limited; (foreign make), the Electrical Company, Limited; meters, Messrs. Ferranti, Limited; brass and copper castings, the Telegraph Manufacturing Company and R. Roberts & Sons; cotton waste, Messrs. W. C. Jones, Limited; wood casing and sundries, Messrs. P. Lloyd Jones and Company, and R. Lambert.

Among tenders for goods for the tramways department, those of the following firms were accepted for rubber hose:—The Rubber Company, of Scotland, Limited (Stirling); the St. Helens Cable Company, Limited; Hellewell & Co.; India-Rubber, Gutta-Percha, and Telegraph Works, Limited; S. M. Jones; G. Maclellan and Company; C. Macintosh & Co.; Northern Rubber Company, Limited; J. Rogerson & Co., and Gibson Bros. The tender of Messrs. Tetlow Bros. for the supply and delivery of seven steel Lancashire boilers at £705 per boiler, was also accepted.

Manchester.—We mentioned last week that Messrs. Mather & Platt had received a contract for surface condensing plant. Tenders were also accepted for cooling towers, three to be supplied by the Wheeler Condenser Company, three by Archibald Koppell, and four by the Klein Engineering Company. Messrs. Higginbottom & Mannock are to supply two electric overhead travellers of 50 tons each; and subway alterations at Stuart Street are to be carried out by Mr. E. Nuttall.

Morecambe.—The tender of the Electrical Power Storage Company has been accepted for the renewal and putting in complete working order of the battery at the East Street sub-station.

Re South Lancashire Scheme.—It having been published that the whole of the equipment for the above central station and sub-station schemes has been placed in the hands of Messrs. Witting Bros., Messrs. Ferranti, Limited, point out that this is not quite correct, for the whole of the switch-gear equipment, both high and low pressure, will be supplied by them for the sub-stations, as well as the central station.

Sunderland.—The Council, on the 12th inst., accepted the tender of Messrs. Crompton & Co. for the supply of 20,000 pairs of carbons.

Barnstaple.—The following is a list of the tenders submitted to the Council for various electrical plant, Mr. Trentham being the consulting engineer. It is exceedingly interesting to note the enormous difference between the highest and lowest tenders in nearly every case, and one is led to ask the reason thereof:—

Section A.—Boilers.

Rensbaw & Co.	£1,691	Johnson & Phillips	£2,36
Babcock & Wilcox (accepted)	1,899	Hornsby & Sons	2,36
Reavell & Co.	1,941	Danks	2,381
British Insulated Wire Co.	1,994	Fraser	2,493
British Westinghouse	2,017	James Carter	2,571
Anderston Foundry Co.	2,121	Lancashire Dynamo Co.	2,64
John Thompson	2,299	Tinkers, Limited	2,870
Davey, Paxman & Co.	2,334	Daniel Adamson	3,226
Newton Electrical Co.	2,365	Ruston Proctor	3,421

Section B.—Steam and Exhaust Pipes.

Crompton & Co.	£1,080	John Spencer	£1,319
John Thompson	1,097	Wheeler Condenser Co.	1,325
Babcock & Wilcox (accepted)	1,113	Newton Electrical Co.	1,861
Johnson & Phillips	1,126	Ashton, Frost & Co.	1,375
British Westinghouse Co.	1,145	Körting	1,651
British Insulated Wire Co.	1,163	Mechan	1,999
Lancashire Dynamo Co.	1,164	Reavell & Co.	2,111
Anderston Foundry Co.	1,167	Klein	2,128
James Carter	1,296		

Section C.—Engines.

Matthew Paul	£1,561	Anderston Foundry Co.	£2,000
Allgemeine	1,707	Jackson	2,014
Allen & Co.	1,755	British Insulated Wire Co.	2,060
Johnson & Phillips	1,768	B. Thomas	2,065
Vauxhall Ironworks Co.	1,773	Thomas Parker	2,065
International Elec. Co.	1,775	E.C.C.	2,169
Royce	1,780	Belliss & Morcom	2,218
Crompton & Co.	1,800	Sunderland Engineering Co.	2,263
Johnson-Lundell Co.	1,900	Howden	2,250
Lahmeyer	1,806	Scott & Mountain	2,275
Schuckert	1,806	Thames Electrical Eng. Co.	2,286
John Fowler	1,842	Reavell & Co.	2,316
India-Rubber Co.	1,843	Holmes	2,358
Witting	1,900	Willans & Robinson	2,627
Davey, Paxman & Co.	1,920	Cannock Chase	2,636
Mavor & Coulson	1,922	Mather & Platt	2,650
British Westinghouse Co.	1,955	Ashton, Frost & Co.	3,600
Howden	1,980	Vereinigte	3,640
Lancashire Dynamo Co.	1,992		

Section D.—Dynamos.

Howden	£1,260	Schuckert	£2,161
Allgemeine	1,441	British Insulated Wire Co.	2,226
Howden	1,550	Thos. Parker	2,259
Reavell	1,563	Holmes	2,287
Broadbent	1,589	Allen & Co.	2,294
Mavor & Coulson	1,678	India-Rubber Co.	2,328
Witting	1,730	Bruce Peebles	2,378
Lahmeyer	1,736	Electrical Construction Co.	2,419
Lancashire Dynamo	1,763	Johnson & Phillips	2,449
B. Thomas	1,817	Jackson	2,483
Veritys, Ltd.	1,839	British Westinghouse Co.	2,486
Royce, Ltd.	1,870	Anderston Foundry Co.	2,588
Thames Elec. Eng. Co.	1,878	Sunderland Forge Co.	2,629
Johnson-Lundell Co.	1,978	Armstrong-Mitchell	4,329
John Fowler	1,988	Combined Sets.	
International Electric Co.	2,030	Newton Elec. Co. (accepted)	3,809
Crompton & Co.	2,119	Parsons	4,790
Siemens Bros.	2,160	Mather & Platt	1,877

Section E.

Fryer	£625	Edison & Swan	£797
Schuckert	629	Dorman & Smith	809
Newton Elec. Co. (accepted)	649	General Electric Co.	811
Statter & Co.	655	Johnson & Phillips	816
British Insulated Wire Co.	661	Elliott Bros.	848
British Westinghouse Co.	665	William-on & Joseph	850
Nalder & Thompson	684	Blackwell	891
John Fowler	690	Siemens Bros.	900
Crompton & Co.	692	Allgemeine	901
Veritys, Ltd.	703	Kelvin	927
Lancashire Dynamo Co.	707	Witting	960
Brook, Hurst	713	Armstrong, Mitchell & Co.	967
B. Thomas	718	Mechan	1,105
Clayton & Co.	737		

Section F.

Anchor Cable Co.	£2,000	Callender	£2,267
St. Helen's Cable Co. (accepted)	2,001	Allgemeine	2,291
Johnson & Phillips	2,141	Telegraph Manuf. Co.	2,374
British Westinghouse Co.	2,199	British Insulated Wire Co.	2,514
Henley	2,238	Newton Electric Co.	2,514
Western Electric Co.	2,262	Glover & Co.	2,681

Section H.—Accumulators.

Schultz	£960	D.P. Battery	£1,319
Ashmore, Benson (accepted)	1,031	E.P.S. Co.	1,427
Johnson & Phillips	1,111	Newton Electric Co.	1,423
Hart Battery Co.	1,142	Tudor Co.	1,436
British Insulated Wire Co.	1,200	Allgemeine	1,472
Lancashire Dynamo Co.	1,200	E. Lomer	1,500
Power Traction Co.	1,215	British Westinghouse Co.	1,520
Veritys, Ltd.	1,265	Chloride Co.	1,624

Section I.—Crane

Chatteris (accepted)	£115	Carrick & Ritchie	£159
Johnson & Phillips	123	British Westinghouse Co.	174
British Insulated Wire Co.	125	Vereinigte	175
Marshall, Fleming	138	Broadbent & Sons	190
Allgemeine	142	Witting	208
Isles	144	Stothert & Pitt	215
Jas. Spencer	145	Newton	220
Lancashire Dynamo Co.	152	John Thorne	315
Carrick & Sons	154		

Section K.—Well.

British Insulated Wire Co.	£ 40	Calyx Boring	£392
Lancashire Dynamo Co.	829	Merryweather	502
Newton	404	Mather & Platt	647
Johnson & Phillips (accepted)	264	Isler	325
British Westinghouse Co.	354	Neal	460

FORTHCOMING EVENTS.

Friday, March 21st.—At 8 p.m. Institution of Mechanical Engineers. Meeting. Papers to be read and discussed:—"Fencing of Steam and Gas Engines," by Mr. H. D. Marshall; "Fencing or Guarding Machinery used in Textile Factories." by Mr. S. R. Platt; "Protection of Lift Shafts, and Safety Devices in Connection with Lift Doors and Controlling Gear," by Mr. H. C. Walker; "Guarding Machine Tools," by Mr. W. H. Johnson.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting in the Marine School, Ocean Road, South Shields. The discussion on Mr. F. J. Warburton's paper on "Some Notes on Steam Turbines" will be resumed, and Mr. Warburton will reply. Paper on "Workshop Records," by Mr. George Parker, A.C.A.

Monday, March 24th.—Institution of Electrical Engineers (Newcastle Section). Meeting. Paper on "The Distribution of Flux in Large Electro-Magnets," by W. M. Thornton.

At 8 p.m. Institute of Marine Engineers. Meeting at 58, Romford Road. Paper by Mr. H. M. Rounthwaite on "Balancing Engines."

Tuesday, March 25th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Meeting at the New Physical Laboratory, Owens College. Paper on "Modern Practice in Polyphase Plant for Power Work," by A. C. Eborall.

At 8 p.m.—Institution of Civil Engineers. Meeting. Paper to be submitted for discussion:—"Subaqueous Tunnelling through the Thames gravel: Baker Street and Waterloo Railway," by Arthur H. Haigh.

NOTES.

Next Week.—We shall be glad if contributors and advertisers will take note that the next issue of the Electrical Review will appear on Thursday morning instead of Friday.

The latest time for receiving Correspondence, Notes and other Editorial matter is 6 p.m. on Tuesday.

Copy for displayed advertisements should reach the advertisement manager's office not later than Monday, 24th inst. "Official Notices" and small pre-paid advertisements can be received up to Wednesday, 26th inst.

Electric Traction now Possible.—A correspondent writes:—"Electrical engineers should be very thankful to Mr. Mordey for his paper read at the Institution of Civil Engineers. Up to the time of writing this, there is still one more evening's discussion. There has been no discussion of the paper itself, but merely remarks, more or less wide of the subject, from a very few members. The thanks of electrical engineers should go freely forth to the civil engineers, for they have learned that the driving of a train by electricity is now possible. Is not this a great achievement? It is actually admitted as proved possible to drive a train by electricity, for the feat has been performed on the Metropolitan, and by a civil engineer, and the fiat has gone forth to the world that the thing can be done. Traction men, to whom the propulsion of trains by electricity appears ancient history, may smile. We adjure them not to smile. The Gospel of Great George Street is that a thing is not done until it has been done by a civil engineer, and a high priest of the civils at that. When one of these has made an experiment upon some long proved problem in engineering, then, and then only, can the world be allowed to know the thing possible. Thus we now know authoritatively that we are at liberty to practice electric traction, for it has been proved possible. We have heard, too, that an electric locomotive will outpull a steam locomotive. This is great news also. We will ourselves add to the storehouse of human knowledge by stating that a jackass, if big enough, will overpull a horse if little enough. We are living in moving times indeed."

Electrical Volunteers.—The body of Electrical Engineer Volunteers, which has been for some weeks in preparation to reinforce the Royal Engineers in South Africa, was to embark in the *Avoca*, at Southampton, on Tuesday.

Overhead Wires.—Lord Morley, Chairman of Committees in the House of Lords, on 12th inst. received a deputation from the London Chamber of Commerce and the Tramways and Light Railways Association. The members urged upon his Lordship their objections to the proposed action of the Postmaster-General, as regards both electrical interference and guard wires, and expressed their wish to be subject to the ruling of the Board of Trade only in these matters.

Institution of Electrical Engineers.—Last night Major-Gen. Webber was to reply to the discussion on his paper on "Electric Shocks," and the paper on "Problems of Electric Railways," by Messrs. J. Swinburne and W. R. Cooper, was to follow.

Central Station Switchgear.—The following references to figs. 17 and 18 were accidentally omitted from our reproduction of Mr. Clothier's paper:—

(A) All machines and feeders connected to one common bus bar.
(B) The system is divided into two halves, with one centre machine and circuit on each side, and inter-connector switch in the middle, by which the two halves can be separated or paralleled.
(C) The system adopted at Croydon and Edinburgh with duplicate bus bars, synchronising gear, feeder and dynamo switches.
(D) Another arrangement with duplicate bus bars, but without duplicating the switches, inter-connector switch being provided to parallel the bars together.
(E) Modification of (D) with three bus bars, as adopted at Huddersfield.
(F) Method of arranging bus bars at Glasgow Central Tramway Station. The system is divided into complete sections by inter-connector switches, so that, if necessary, any machine can run separately on to one section of feeders.
(G) Represents connections at Kensington and Notting Hill supply station, where the complete switchboard is divided into four sections, including two sections for machines and two for feeders, with a ring main system of bus bars and switches, by which either of the dynamo or feeder sections can be run together respectively.
(H) Connections for the obsolete system of independent running, where any generator can be run separately on to any number of feeders.
(I) Suggested bus bar arrangement, where it is necessary to divide the system into two sections as for tramway and lighting purposes. The two machines in the middle can be connected to either traction or lighting bus bars by knife switches shown on the bus bars.
(J) Arrangement of connections for a switchboard with duplicate bus bars for tramway and lighting purposes respectively, a system of inter-connector switches being shown, by which either of the four sets of bus bars installed can be synchronised or coupled. The drawing shows the method of connecting the cable-charging device.
(K) The switchboard connections on the basis of the design used for the Metropolitan Street Railway Company, New York, where the system is divided into two sections, the feeders being arranged in groups. Each sub-station is connected by a feeder or feeders from either side of the central station switch gear.

The diagrams do not represent the actual number of machines in use at places mentioned, but by way of comparison they denote the methods as applied to four machines and eight feeders. They also serve to show the relative space occupied by these arrangements.

500-volt Battery Shocks.—We wish to make it quite clear that in our reference to the battery of Messrs. Sutherland and Marcuson, in last week's issue, which was used in Mr. Trotter's lecture table demonstration, we had no intention of reflecting on the merits of a most useful apparatus. The makers were good enough to submit a box of cells to us, which, as we said, seemed out of order. We have since learned that it was practically empty; but that was not our fault, for it was tested as we received it. Mr. Trotter's sets appear to have been quite good, but these cells, we are informed, are not designed to have a low internal resistance, nor to have a great capacity; they are intended to give pressure in a light and handy form. Messrs. Sutherland & Marcuson are also makers of large batteries for ordinary purposes, and if our remarks should have had the effect of creating an impression that they, too, have a high internal resistance, we hasten to remove it.

From other quarters we are told that visible proof was given at the meeting—in the shape of a large bank of lamps incandesced by the battery current—that (*a*) the battery was not out of order, and (*b*) its internal resistance was not of the abnormal kind we suggest. Furthermore, it is roundly asserted that the Sheffield fatality was not due to electric shock at all. Concerning (*a*) we understand that the lamps Mr. Trotter ran were 100-volt 5-C.P., so they would be run in five sets in parallel of five lamps in series. There is nothing startling in this. With regard to (*b*) the reply to Mr. Casson, in our "Correspondence" columns, will meet this point. We can only say so far as the Sheffield fatality is concerned, that Mr. Rawlins, an electrician in the employ of Messrs. Vickers, Sons & Maxim, who was with the deceased at the time of the accident, and who tried artificial respiration during the 10 minutes or so the poor fellow lived, attributes death to an electric shock, and the jury found that deceased was accidentally killed by electricity. (See *Sheffield Daily Telegraph* for March 4th.)

Where is the man who, having been engaged in the operation of testing cable core with batteries of high voltage, has not received messages couched in anything but Parliamentary language from that important, albeit humble, official who connects the leads to the core, asking why the battery had not been taken off? Nearly every day these men are subjected to shocks far stronger than those which Mr. Trotter experienced in his lecture table exhibition.

We did not lay much stress upon the innocuous nature of these battery experiments, because we thought that everybody would value them at just what they were worth; but it is not a little surprising to find electrical engineers taking them quite seriously because they have seen that 50 cells will incandesce an 8-C.P. lamp; such exhibitions must not therefore be ignored, but gravely considered as having an important bearing upon our knowledge, or want of it, of the subject of electric shocks.

With such people seeing is believing; but if they turn to page 766 of the ELECTRICAL REVIEW for June 30th, 1893, they will find there recorded an experiment of D'Arsonval's, which may both surprise and interest them.

Had Mr. Trotter used a Chloride of silver battery of 14,000 volts, such as that employed years ago by Mr. de la Rue, we are fain to believe that many of his audience would have expected to see only a grease spot left of the bold experimenter.

We cannot be held responsible for the inability of "Meteor" to see that a battery's internal resistance of 500 ohms can "make no appreciable difference to the current it would send through a resistance *as high* as that of the human body;" not even, we suppose, when *as low* as 1,000 to 1,500 ohms, which has frequently been found. "Meteor" might oblige us by carefully perusing that portion of our article devoted to Mr. Hooper's tests at 100 to 125 volts pressure when one's hands are grasping metal.

Finally, it is difficult to imagine anything more inconclusive than Mr. Trotter's conclusion to the letter we publish from him. We should have thought that to men engaged in dangerous trades, the discussion of what *is* dangerous would have been more to the point; the technical adviser to the Board of Trade confesses that he simply tells us what has certainly been known for years, the rest is mere assumption, and not correct even at that, for far heavier currents than he records are frequently used for curative ends. Everybody knows, or should know, that with a *high* skin or body resistance, there is little probability of getting a fatal shock from a pressure of 500 volts but it is the *low* resistance of 1,000 to 2,000 ohms which we have to consider, and which we did consider, in our article of last week; this, however, it suits Mr Trotter's advocates to ignore, although the crux of the whole thing lies in the dangerous shock, and not in the tame "pricking stings" or "standing on hot steam pipes" sensation.

Personal.—It is announced that the Home Secretary has appointed Mr. Gilbert Scott Ram, M.I.E.E., to be Electrical Inspector of Factories and Workshops.

Mr. M. B. Mountain, who for the past three years has been the shop manager of Messrs. Crompton's Works, Chelmsford, was on Saturday evening the recipient of a presentation from the employés on the occasion of his leaving Chelmsford. He has obtained an appointment at Manchester.

Mr. Douglas Farrar, B.Sc., has been appointed to the vacant assistant-lecturer in electrical engineering in the University College of North Wales.

Mr. F. Charles Raphael has been appointed as electrical inspector for the borough of Chatham, and also for the adjoining city of Rochester. Both the Rochester Corporation and the Chatham Town Council were unanimous in this appointment, and, subject to the sanction of the Board of Trade, Mr. Raphael's scale of fees are agreed to.

Last week the Bilston employés of the British Electric Traction Company presented to Mr. W. A. Davis, the local superintendent, a basket of cutlery on his removal to Sedgley to act as manager for that section of the tramways.

Mr. R. W. Barnsdale, who has for some years been with Messrs. Willans & Robinson, of Thames Ditton, is leaving the district to take up a position at the company's works at Rugby.

Mr. H. F. Parshall is, to-morrow (22nd inst.), removing his offices from 8, Princes Street, Bank, E.C., to Salisbury House, London Wall, E.C.

Concert.—The staff of the ELECTRICAL REVIEW held their last smoking concert for this season on Friday last week. Mr. W. G. Wicken presided, and a capital programme was carried out, greatly to the enjoyment of the staff and their guests—one of whom, Mr. T. H. Harrison, contributed some excellent songs, and was most heartily encored.

For Sale.—The Manchester Corporation Electricity Committee are prepared to receive offers for the purchase of four vertical compound Galloway engines of 400 I.H.P., running at 80 revolutions per minute; and four 250-KW. shunt-wound dynamos, 400 revolutions per minute, with belts and jockey pulleys complete, now at the electricity works, Dickinson Street. It is offered for sale to make room for larger units, but the Corporation do not bind themselves to accept the highest or any tender. Tenders to be received by the chairman of the Electricity Committee not later than Tuesday next.

National Physical Laboratory.—On Wednesday the Prince of Wales opened the National Physical Laboratory at Bushy Park, Teddington. We shall deal with the matter in our next issue.

Appointment Vacant.—Distributing assistant at £150 for Belfast.

THE CENTRAL STATION ENGINEER.

THE King's Lynn T.C. has appointed Mr. J. M. MARGETTS, of Chelmsford, to be third assistant engineer at a salary of £80 per annum.

Mr. G. E. SMITH, chief assistant to the Guernsey Electricity Supply Company, has been appointed resident engineer to the Urban Electric Supply Company at Dartmouth.

The *Ceylon Observer* says that Mr. R. M. BAIRD arrived at Kandy last month to succeed Mr. J. E. Addyman as resident electrical engineer to the Colombo Gas and Water Company's electrical power and lighting station there. Mr. Addyman is stated to be returning home, he having fulfilled his engagement.

A presentation to Mr. G. K. Nowlan took place at the electricity offices of the Harrogate Corporation on Monday evening last, on the occasion of his leaving the employ of the department to take up a position with the British Insulated Wire Company, Limited, at Prescot. Mr. Wilkinson, the engineer-in-chief of the department, in making the presentation, referred at some length to the conscientious and able manner in which Mr. Nowlan had discharged his duties whilst under him, and ended by asking him, on behalf of all the subscribers, to accept a silver cigarette case with a suitable inscription, together with a silver match-box suitably initialled, as a small token of the esteem and regard borne towards him by the officials and employés alike.

CITY NOTES.

City of London Electric Lighting Company.

The annual meeting of the proprietors of this company was held on Wednesday of last week at Winchester House, Old Broad Street. Mr. George Herring presiding.

The Chairman, in proposing the adoption of the report, after referring to the retirement from the board of Sir David Salomons, on account of ill-health, said the revenue for the year 1901, amounted to £250,000, as compared with £223,000 for 1900, being an increase of £27,000. The expenditure during the past year had been £148,000, as against £171,000. There was a gain, therefore, of £27,000 in the receipts, and a decrease of £23,000 in the expenses, or practically a gain of £50,000 over 1900, and he thought they would agree with him that that was not a bad showing. They had had to pay £27,000 for debenture interest in 1901, as compared with £19,000 for 1900, so that there appeared to be a deficiency of £8,000, but it was really £5,200, as they had had to pay less interest on loans. The price per unit had been slightly in advance of 1900 — half a farthing per hour for each 8-c.p. light. During the past year they connected up 38,000 more lights, making a total of 549,000, and that increase had been accomplished in face of the competition of the Charing Cross Company. He thought a gain of 38,000 spoke very well for the efficiency of the light and for the manner in which the company had been managed. The expenses of generation and distribution stood at £85,000, as compared with £106,000, being a decrease of £21,000. There had been a saving on the coal bill of £22,000, and it would be naturally thought that that was in connection with the price, but he was happy to say that that was not the case, for, as a matter of fact, according to the accountant's figures, the company paid in 1900 18s. 8d. per ton for coal, and last year the average price was 19s. 11d. Therefore, it appeared to be a wonderful result to have saved £22,000, and paid 1s. 3d. per ton more. The explanation he had to give was that they had burned 78,000 tons in 1900 and 55,000 tons in 1901—a reduction of 23,000 tons, which satisfactory result was entirely due to their engineer. They had generated 250,000 more units last year than in 1900, and had burned 23,000 tons less coal, and had saved £22,000. The directors were merely responsible for recommending the payment of a dividend of 5 per cent. for the year, and if the shareholders saw any reason why that sum should not be paid, they could reject the resolution. He thought it only right for him to explain the directors' reasons for recommending the distribution. In the first place, the amount of money shown had been undoubtedly earned, and in the next place, all charges had been deducted. It only remained for the shareholders to judge whether enough had been placed on one side for depreciation. He contended that they had allowed sufficient for depreciation. They had kept in the business this year £56,000, or, in other words, £25,000 had been put to maintenance fund, £15,000 to reserve, £15,000 was being carried forward, and a sum of money was being retained as interest on the redemption fund. From the £56,000 must, of course, be deducted the amount spent in repairs—roughly, £18,000—leaving a balance of £38,000, which the board claimed was sufficient. Credit must be given them for keeping the plant in first-class order, for, if they did not do so, customers would be lost and also the economies they were practising. Their engineer reported that the plant was never in better condition than at the present moment. Then came the question, why should they hold up a huge reserve fund? They had at the moment £160,000, irrespective of what he had mentioned. They had 30 years to run, and if they put £20,000 a year aside—let alone £38,000—it would amount to very nearly a million of money apart from what they had in hand. At the end of 30 years they might find that they had prepared a rod for their own backs, as the Corporation might say, "Look what they value it at themselves; they don't value the plant at much more than 6s. 8d. in the £," and the Corporation would only give the company that value for it. Therefore he did not feel inclined to build up a huge reserve fund; but he did think it was advisable that they should have a good reserve, because a number of contingencies might occur. He would rather say let them hope that at the end of 30 years a new Corporation might be in existence which would have arrived at the conclusion that the repudiation of agreements and the confiscation of property was not beneficial to the Corporation of the greatest city in the world. Coming to the dispute between the Corporation and the company, he was sorry to trespass upon the time of the meeting, but he was unfortunately compelled to refer to the matter because it had been said that the board had committed a breach of faith. It must be remembered that the company was formed on the basis of three contracts—one for the western, one for the central and one for the eastern. Those contracts they asserted—and it had never been proved to the contrary—had been faithfully kept up by them, but the Corporation for reasons quite unknown had determined to repudiate them upon the plea that two members of the Corporation had bought some shares—he thought 35 in all—and according to an old Act of Parliament, stated by the Corporation, the contracts were thus rendered invalid. The Corporation had dragged the company through the Law Courts at the ratepayers' expense, and at last succeeded in getting the Appeal Court to decide that two of the contracts were invalid, and that the eastern one was valid. A conference was held some months afterwards between the Corporation and the board. They met in a friendly spirit, and all the various points were discussed, amongst others being the question of litigation, and it was mutually agreed to stop all proceedings. As to contracts, the chairman (Ald. Smallman) said they also would be dropped, but he (Mr. Herring) replied that they could not drop the eastern contract, as it had been declared valid. Mr. Smallman stated that on a new agreement being carried out, it would naturally drop. He (the speaker) had then remarked that, although the company had no desire to be unfriendly, their past experience of repudiation of the contracts by the Corporation did not induce them to drop the one contract declared to be valid, and they would stick to it. At the second conference the contracts were not mentioned, but it was arranged that the heads of the agreement should be sent to the company, which was eventually done, and on looking through the heads of the agreement, it was found that the first clause stated that the company was to give up the eastern contract. The board had at once altered that clause, and made a few other trifling alterations, and the document was returned to the Corporation. On the Thursday morning following he was informed that Mr. Smallman had spoken in strong terms of the alterations made, and he had consequently written to that gentleman, stating that it was never intended to consent to the cancellation of the contract for the eastern district. He had made that clear at the first conference, and believed that a reference to the shorthand notes would show that was so. No reply, however, had been received to that letter. Mr. Smallman went to the Corporation and declared that the company had committed a breach of faith. It was now for the shareholders to judge whether the board of the company had committed a breach of faith. They would, no doubt, like him to say something about competition, but as that was rather a delicate subject to deal with, he would rather not go into it. He would simply give them his personal views, which were that if they continued to give a good light, and charged a low price, they need have no fear of either the persecution of the Corporation, or the competition of the Charing Cross Company.

Mr. J. Braithwaite seconded the motion, which, after a short discussion, was adopted.

Imperial Tramways Company.

The directors' report to be submitted at the meeting to be held at Bristol on Wednesday, March 26th, reads as follows:—

"*Middlesbrough, Stockton and Thornaby Electric Tramways.*—The gross receipts of these electric tramways amounted to £48,772 17s. 1d., and the number of passengers carried to 9,141,183, compared with totals of £47,218 17s. 9d. and 8,782,970 in the preceding year. The extension to Clarence Ferry was opened for public traffic in August last, and the additional accommodation is much appreciated by the public of Middlesbrough. The net profits of the year show that the return of 6¾ per cent. is maintained upon the increased capital expenditure.

"*Corris Railway Company.*—The operations of the year resulted in a dividend at the rate of 5 per cent. on the share capital, the whole of which is held by this company.

"*London United Tramways, Limited.*—During the past year the London United Company have made very great progress, the feature of the year having been the introduction of electric traction on their system. Some of the lines were opened in April and others in July, when the public ceremony of inaugurating the first electric tramways in the metropolis was performed by the Right Honourable the Lord Rothschild, supported by the Right Honourable A. J. Balfour, M.P., and other Cabinet Ministers, as well as the leading representatives of the financial, engineering and scientific world. The undertaking launched under such unique auspices has from the first been attended with the most gratifying public success, and the profitable results of its operation have more than justified the directors' anticipations. The revenue derived from the shares in the London United Company held by this company amounted to £25,520 for the past year. At the close of that period the undertaking was sold to a new company—the London United Tramways (1901), Limited, upon terms which will give the Imperial Company a substantial profit. In respect of its holding of 29,000 6 per cent. preference shares and 6,000 ordinary shares in the old company, it will receive 34,800 5 per cent. preference shares and 12,000 ordinary shares in the new company, together with about £58,000 in cash. As the affairs of the old company are not yet closed up, none of the benefits of this transaction is included in the Imperial accounts now submitted, but will accrue during the current year. The directors, however, contemplate distributing in specie some of the ordinary shares of the new London United Company amongst the holders of Imperial ordinary shares by way of interim dividend and the necessary formal addition to the Imperial Company's articles of association will be proposed at the forthcoming meeting.

"*General.*—Since the last report arrangements have been concluded by which the tramways at Reading and Darlington have been transferred to the respective Corporations, and the revenue accounts are brought down to the dates of handing over in each case. The

proceeds of sale have been credited to the capital account, and the difference between the profit on Darlington and loss on Reading charged against the reserve fund for contingencies. It will be seen that the company's net revenue account for the year shows an available balance of £43,846 2s. 6d., and after payment of interest on the debenture stock for the whole year and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £25,371 10s. 8d., it is proposed to appropriate the balance as follows:—Dividend at 6 per cent. per annum on the preference capital (paid on January 1st last), £5,702 12s. 11d.; final dividend at 11½ per cent. per annum (making 10 per cent. for the year) on the ordinary capital, £11,500; to add to the dividends equalisation fund, £1,000; and to carry forward to the next account the remaining sum, £271 18s. 11d. The reserve funds will then be increased from £72,789 to £92,470. Mr. Hugh C. Godfray, director, and Messrs. James Fraser & Sons, auditors, retire at the ensuing meeting, and will be proposed for re-election. The directors recommend the election of Mr. Samuel White, who is about to resign the secretaryship, as an additional director, and he will be accordingly proposed at the ensuing meeting."

Evered & Co., Limited.

The directors' report shows that, after providing for debenture interest, amounting to £2,359 7s. 5d., and income-tax, £1,626 4s. 4d., a net profit of £12,870 2s. remains, making, with £6,163 12s. 4d. brought forward from 1900, and £4,000 transferred from the fund for the equalisation of dividends, the sum of £23,033 14s. 4d. to be dealt with. It is proposed to pay a dividend at the rate of 10 per cent. for the year, which will absorb £17,074 8s. (of which sum £6,402 18s. was paid as interim dividend in September, 1901), write off plant £1,000, and to carry forward to next account £4,959 6s. 4d. The directors announce a reduced amount of profit. The fall in the price of copper at the end of the year necessitated the stocks both of raw metals and manufactured goods being taken at considerably reduced value; also the keen competition in some of the departments has contributed to the reduction in profits, which they trust will prove only temporary. The directors have succeeded in maintaining the volume of trade. The directors have taken from the equalisation of dividends fund the sum of £4,000 to enable them to pay the the dividend as above.

The Metropolitan Electric Supply Company.

The fifteenth ordinary general meeting of the shareholders of this company was held on Tuesday at Winchester House, Old Broad Street, Mr. W. Harrison Cripps presiding.

The Chairman, in proposing the adoption of the report, dealt first with the capital account. They had, he said, spent £201,995 on that account during the year. At first sight that appeared a large sum, but the great bulk of it was for providing new engines and buildings at Willesden, and for the change-over in Marylebone from the alternating to the continuous current. Practically, the whole of that sum was unremunerative during the year, and would not become remunerative till the change-over actually took place in the present year. Nevertheless, according to the custom of the company, the interest on the whole of this sum had been borne by the income of the year. Part of the extensions of Willesden would be completed in the course of the present summer, when the first of the two additional engines of 3,000 kw. each would, it was expected, be ready by the autumn, and it was hoped that the continuous current system in Marylebone would be sufficiently advanced for changing over. Owing to the fact that the Marylebone arbitration was to come on this spring, and that a large sum of cash would be due to the company, the directors would have carefully to consider how that purchase money was to be disposed of, and whether its disposal would entail any alteration in the present arrangement of the company's capital. In view of that purchase money being paid over during the year, it was thought unadvisable to issue any additional capital at the present moment. They therefore made arrangements for temporary advances to the amount of £150,000 from their bankers, and he thought it spoke well for the high position that the company occupied that that large loan was obtained without the slightest difficulty. Turning to the revenue account, it would be seen that the number of units sold was 11,122,000, being an increase of 1,267,000, and that the revenue from that source, with the rental of meters, amounted to £235,422. That was £26,452 more than was received in 1900. The increase had not been quite so much as in that year, although the number of lamps connected was larger than in 1900. The slight slackening in the rate of increased current sold was chiefly due to the quiet character of the season, consequent on the death of her late Majesty. The cost of earning the total revenue was £144,€80, which was an increase of £13,761 as against the increase of £26,452 in revenue. Of that increase in cost, rates and taxes represented an increase of £3,404, and coal and increase £3,802. As regarded the price of coal, it must be remembered that during the last two years it had been extraordinarily high, and if the price paid had been only the average of the last 12 years, the company would have saved £14,000, which was equivalent to nearly 1½ per cent. of dividend. It must be remembered that the whole of that increased charge for coal had been paid by the company, without obliging the consumers to bear any part of it by increasing the price of current. Fortunately the price of coal had rapidly fallen, and they had now before them for acceptance tenders for the supply required during the remainder of the year at prices which, if they had been in operation last year, would have saved the company upwards of £10,000, a sum equal to 1 per cent. on the ordinary capital. Notwithstanding the exceptional additions to working expenses, there remained a profit of £91,000 as compared with £78,500 last year. Out of that they transferred to the credit of the depreciation reserve fund the sum of £10,000. It was gratifying to see the continual and progressive increase of the company's business. In laying down their plant and calculating the requirement of future years, it was assumed that as house after house was connected to the system, and thus the proportion of unconnected houses became fewer, the rate of yearly increase in lamps must diminish. The experience of the company—and that of most others, however—had shown that assumption to be entirely wrong, and notwithstanding the residue of houses becoming smaller, the number of lights required went on at the same steady ratio. They thought that there was no assignable limit to that increase. The consumption of light seemed to obey the law applicable to all commodities, and the luxuries of one year became the necessaries of the next. It was in that increased demand, and with the certainty that the cost of production would be diminished, that the prospects of the company were bright in the future. Referring to the arbitrations shortly to come on, the chairman said that with respect to their Sardinia Street station, the County Council three years ago obtained a Bill for making a new street between Holborn and the Strand. That would necessitate their taking the whole of their Sardinia Street station. The company opposed the Bill, but Parliament sanctioned the County Council scheme on condition that the Council should vest in the company a new site, which had been agreed upon, and pay to the company a sum equal to the cost of erecting and fitting up a new generating station upon the new site with new plant of a capacity to generate and supply electrical energy of an output of not less than 4,000 kw., and also pay all expenses to be incurred by the company in connection with taking up, replacing, relaying, and altering mains owing to the removal of the generating station from Sardinia Street to the new site, both sums to be settled by arbitration under the Lands Clauses Act. The arbitration had been delayed owing to the desire of the Council to get an interpretation from the judges of the meaning of one clause in the Act. The decision in the Court of First Instance was given in favour of the Council. That decision was reversed in the Court of Appeal and given unanimously in favour of the company. The Council then took the case to the House of Lords, who with equal unanimity, reversed the decision of the Court of Appeal, an instance of the glorious uncertainty of the law. Now that this point had been decided, there was nothing to prevent the arbitration coming on at once. As to the second pending arbitration that was of vital importance to the company—he referred to the sale of a portion of their undertaking to the Borough Council of Marylebone—he would not weary them with going all over again the history of their difficulties with the parish authorities. They were jealous of the company the moment its success seemed assured, and subjected them to all sorts of vexatious delays in the development and progress of their business. In three different sessions they sought Parliamentary powers to compete with them, with the aid of the ratepayers' money. They successfully opposed their intention, and now, after 12 years' working, they were absolutely free from any form of competition in Marylebone. Nevertheless, those attempts to destroy their property, and the various delays and opposition to the progress of their work, involved the company in much anxiety and heavy expense. Last session when it became evident that the Borough Council would again fail to get powers to compete with them, they changed front, and Parliament gave them compulsory powers to buy them out by arbitration under the Lands Clauses Act. They were, therefore, now in the position of being obliged to sell a part of their undertaking at a time, when, after years of patient waiting, and the expenditure of a large amount of hitherto unremunerative capital, the shareholders were on the verge of reaping an adequate reward for their enterprise. Being in the position of unwilling sellers, they had every confidence that under the Lands Clauses Act the arbitration would result in the award of a fair compensation for that compulsory sale of the best portion of their property with the damage that its severance would occasion to the remainder. He need hardly say that the directors would spare no trouble in seeing that their case was fully and fairly presented at the arbitration.

Sir James Pender, Bart., seconded the motion, and the report was adopted.

Hove Electric Supply Company.

The tenth annual general meeting of the shareholders of this company was held on Wednesday last week at Salisbury House, London Wall, Col. A. J. Filgate presiding.

The Chairman, in moving the adoption of the report, said that considering the heavy increased charge they had had to meet on account of coal, and the very largely increased assessment for rates and taxes, the result of the year's working could not be thought to be unfavourable. During the year the capital expenditure had amounted to £9,215, and the total expenditure to £109,738. In addition to paying for a new generating station, the company had constructed a new coal bunker which had been much needed at a cost of £290. They had also expended £1,055 on an additional Babcock & Wilcox boiler, and £550 on an induced draught apparatus to supplement the chimney-stack, which had not been built to deal with the large load they now obtained. The company had added to and strengthened their mains at an expenditure of £2,680; the present length of their mains was nearly 17 miles. They had expended the sum of £1,063 on meters, and £575 on electrical instruments, &c., the latter being chiefly in additions and improvements to the switch-

board. As he had told them last year, after considerable trouble they had acquired a suitable site for the new generating station, and by the courtesy of the L.B. & S.C. Railway, the company were arranging to lay their mains a short distance alongside of the railway, and had matured plans for the new station, which plans were shortly after laid before the Hove Corporation for their approval. The Corporation had withheld their consent for some considerable period and had made them add no small sum to the cost of the building. When in August they finally passed the designs, they informed the company that they did it solely under the provisions of the Sanitary Act, and without reference to their position in connection with the company under the indenture transferring the electric supply order to their undertaking. Application was then made by the company for the necessary sanction to the erection of the building under the provisions of the contract, in which it was provided that all buildings were to be erected to the reasonable satisfaction of the Council, but to that very reasonable request they could get no definite reply. After a deal of correspondence, they were invited to meet the Electric Lighting Committee on December 16th. At the meeting no legal question was raised, but the Corporation contended that the present station could give a considerably larger supply of electricity than their present demand. Their desire, of course, was to always have a reserve in hand in case of accident or emergency. The Committee dealing with the question adjourned without coming to any decision, and after some more delay they were told that they had nothing to add to some letters written back in the summer. They then suggested that the matter should be referred to arbitration, and receiving only a vague reply, they placed the matter in the hands of their legal advisers and demanded arbitration. That brought forth a reply that in the opinion of the Corporation their consent was not necessary, and the proposed building was not one of the works contemplated in the contract of 1892. Further letters passed, and in the end the Corporation said they did not consider the additional works to be necessary. They were, however, advised that with their steadily increasing demand they were necessary, and although, with good fortune, they might possibly meet their obligations next winter, it was not safe to do so. There was no doubt that if they were to reduce their charges they would get a large additional number of consumers, but it would be very foolish to attempt to attract a larger demand until they were in a position to meet it. They had, therefore, decided to commence the new station, but it was very doubtful if they would be able to complete it in time for next winter's load. They were still at issue with the Corporation on another matter, viz., the change of the older customers from the 110-volt to the 220-volt pressure. In 1896 the Corporation gave their consent to new customers being supplied at the higher pressure, but stated that their consent would be required in each case where an old customer wished to transfer. It was apparent that the Corporation delayed their consent to any such applications as long as they possibly could, and, by so doing, they were acting against the interests of the ratepayers and the company's customers. Since January 1st, 1901, 25 consumers changed over from 110 volts to 220 volts, and at the present time they had 188 houses on the 110-volt and 742 on the 220-volt pressure. 34 additional customers had applied to be changed over, and 27 applications were still before the Corporation. Having referred to the issue of 1,000 shares to the shareholders last autumn, of which 745 were subscribed for, the chairman referred to the revenue account. The number of houses on the system at the close of last year was, he said, 921—an increase of 119 during the year. At the close of the year the lamps and motors on the system reached the equivalent of 61,366 8-c.p. lamps, against 52,919 at the end of 1900, and the units sold to customers amounted to 629,427, compared with 559,208 in 1900. The gross revenue for the year had amounted to £15,519, as against £13,841—an increase of £1,677. The expenditure had amounted to £7,237, against £6,125—an increase of £1,112. Their coal had cost them £526 more, and although the price was still high, they might hope for a considerable reduction this year. The balance of the profit and loss account was £8,554. After providing for the interim dividend paid in October last, there was a balance remaining of £5,437, and the board recommended that £2,250 should be placed to the credit of the reserve account, and a final dividend be paid at the rate of 7 per cent. per annum, which would make a dividend of 8 per cent for the year. He was glad to say that, so far as the current year had gone, a satisfactory increase in the demand for electricity was shown.

Colonel H. WOOD, C.B. seconded the resolution which, after a short discussion, was agreed to.

The retiring director having been re-elected, a resolution was agreed to, increasing the fees to be paid to the directors to £150 each per annum, with an additional £100 for the chairman—the increases to date from the commencement of the present year.

Pontypool Electric Light and Power Company.

THE annual meeting was held on Thursday last week. The report of the directors showed that the running of the station for the year ending December 31st last had resulted in a profit of £737 18s. 10d., after carrying £100 to revenue account and wiping £70 3s. 4d. off preliminary expenses. After deducting debenture interest amounting to £204 4s. 10d., a net balance remained of £533 14s., which was dealt with as follows:—Carried to reserve revenue account, £50; to debenture redemption account, £150; a dividend of 5 per cent. on the paid-up capital for the year; and the balance of £71 13s. was carried towards redemption of charges on capital account.

Davis & Timmins, Limited.

SIR HENRY MANCE presided at the annual meeting of this company on 14th inst., and in moving the adoption of the report, of which we have already published an abstract, said that the expansion of the business had continued, in spite of keen competition and the absence of business from the War Department. The Wood Green factory had enabled them to undertake certain classes of work with which they were previously unable to deal, and orders had been executed with greater economy and celerity. The prospects for the business were good. The gas generating plant had been found to be most economical, and they had every reason to be satisfied with the adoption of electricity for motive power. The chairman then proceeded to refer to the accounts. The stock, he remarked, had been slightly increased, but he would like it to be even more than it was, because they desired to keep in stock, ready for delivery to customers, a specimen of every one of the articles in their advertised list, which numbered nearly 800.

The resolution adopting the report and declaring an 8 per cent. dividend was then unanimously passed.

National Electric Wiring Company.

THE report of directors reads:—

The directors submit their report and statement of accounts to December 31st, 1901. The gross profit for the period under review is £12,664 14s. 7d., from which have to be deducted expenses of administration, allowances on contracts, &c., amounting to £6,060 10s. 8d., leaving a balance of £6,604 3s. 11d. To this has to be added the balance carried forward at December 31st, 1900, viz., £384 5s. 9d., making a total of £6,988 9s. 8d.

The directors recommend that this amount be dealt with as follows:

To pay a dividend at the rate of 5 per cent. on the paid-up capital for the year	£4,093	12 1
Provision for further allowances, depreciation, &c.	2,522	7 8
To carry forward	372	9 11
	£6,988	9 8

The directors have pleasure in stating that the increase in the business during the year has again been satisfactory. The orders taken from January 1st of the current year to date of this report show that the increase has been maintained. During the year 2,741 installations, with an aggregate of 79,843 lamps of 8 c.p. have been completed, of which 805 installations, with an aggregate of 25,080 lamps of 8 c.p., were free wiring, and 1,936 installations, with an aggregate of 54,763 lamps of 8 c.p. were contract; while the orders in hand at the close of the year were 315 installations with an aggregate of 29,342 8-c.p. lamps. Free wiring contracts have been entered into with the metropolitan borough of Hackney and the Hornsey District Council. The directors regret to state that, for business reasons, Mr. J. W. Swan resigned his seat on the board during the year.

Willans & Robinson, Limited.

THE half-yearly report to be submitted to the meeting at the Cannon Street Hotel on Wednesday, March 26th, reads as follows:—

The accounts for the half-year ended December 31st, 1901, are submitted herewith. After writing off as depreciation from plant, &c., the sum of £6,114 5s. 2d., and paying interest upon debenture stock, the balance to the credit of the profit and loss account at the end of the half-year (including £6,457 1s. 1d. brought forward) is £39,804 9s. 4d. Out of this the directors propose that dividends be paid at the rate of 6 per cent. per annum upon the preference shares and 10 per cent. per annum on the ordinary shares, amounting in all to £22,531 15s. 10d. The amount payable to directors in accordance with the articles of association, and with the resolution passed by the shareholders on October 2nd, 1901, is £4,737 2s. 4d., leaving an available balance of £12,535 11s. 2d. From this the directors propose to carry £2,000 to the debenture redemption fund and £3,500 to the reserve fund, leaving a balance of £7,035 11s. 2d. to be carried forward. A further sum of £20,000 has been transferred from the premiums and shares account to the reserve fund, raising the latter (if the above proposal to transfer £3,500 from the last half-year's profits be also taken into account) to £111,146 9s. 11d. The boiler works at Queen's Ferry have made satisfactory progress, and one section, the steel making department, is at work. The quality of the steel produced has been excellent, and the directors look forward with confidence to the development of the steel manufacture, and to the financial results of the boiler work generally. The trials of the Niclausse boilers of H.M.S. *Fantome* are understood to have given very satisfactory results, and the Admiralty have recently ordered another similar vessel to be built and fitted with Niclausse boilers. They have also called for tenders for Niclausse boilers for several larger vessels, but it is understood that no decision with regard to these has yet been arrived at. Whatever may be the judgment of the Admiralty, the directors, as they have stated before, are entirely satisfied as to the amount of boiler work to be done for land service, and to complete the equipment of the works on the scale which is desirable, and to provide working capital for the future, as well for the engine as for the boiler business, they ask authority to make an issue of £250,000 of debenture stock (which as regards £100,000 will merely take the place of the existing issue) in such amounts and at such times and at such rate of interest as they may deem best. A resolution to this effect will be submitted to the shareholders at the meeting. It is hoped that an arrangement will be effected with the present debenture stockholders for the exchange of their present stock for stock of the new issue. Mr. Robinson and Sir Gilbert A. Clayton-East retire from the board, in accordance with the provisions of the articles of association, but are eligible and offer themselves for re-election. The auditors, Messrs. Cooper Brothers & Co., also retire, but are eligible for re-election.

County of London and Brush Provincial Electric Lighting Company.

THE report to be presented to the shareholders at the meeting to be held at Winchester House, at 2.30 o'clock, on Monday, March 24th, reads as follows:—

The directors beg to submit their report and statement of accounts for the year ended December 31st, 1901.

Capital.—The capital expended during the year in respect of the company's London districts, amounted to £129,781 11s. 9d., making the total expenditure on account of those districts up to December 31st last £1,022,458 14s., particulars of which are given in capital accounts, Nos. 5, 7, 9, 11, 13, 15 and 17, and in the balance sheet. This expenditure has been met by the sale of the balance of the unissued 4½ per cent. debenture stock in February, 1901, at the price of £103 per cent. net, and by the issue of a further £100,000 6 per cent. preference shares, allotted *pro rata* to the shareholders in October last at a premium of £2 per share. The premium received on the above-mentioned issues has been applied in the following manner:—

To reduction of preliminary expenses	£1,538	3	11
To reduction of costs of pending applications for provisional orders	500	0	0
To amount carried to reserve for depreciation, repairs and renewals, &c.	9,159	5	11
To amount carried to reserve	8,265	0	2
	£19,462	10	0
Revenue.—Balance from last account after payment of the final dividends on the preference shares and the ordinary shares of the company, for the half-year ended December 31st, 1900, less income-tax	£2,683	14	1
Balance from revenue account No. II., after payment of directors' fees, rent, taxes, general establishment and other charges, wages and proportion of salaries ..	43,944	19	0
Making a total available revenue for the year 1901 of ..	£47,583	13	1
From which must be deducted the following items:—			
(*a*) Interest on debenture stock, including interest on instalments paid in advance, less income-tax	£16,987	10	0
(*b*) Interim dividend on 20,000 6 per cent. preference shares for half-year ended June 30th, 1901, less income-tax	5,675	0	0
(*c*) Interim dividend on 40,000 ordinary shares at 4 per cent. per annum for half-year ended June 30th, 1901, less income-tax	7,566	13	4
	30,229	3	4
Leaving for further distribution	£17,354	9	9

The directors recommend:—

(*a*) That payment of the interim dividend on the 20,000 6 per cent. preference shares for the half-year ended June 30th, 1901, less income-tax, be confirmed.

(*b*) That payment of the interim dividend on the 40,000 ordinary shares at the rate of 4 per cent. per annum for the half-year ended June 30th, 1901, less income-tax be confirmed.

(*c*) That a further dividend on the 20,000 6 per cent. preference shares for the half-year ended December 31st, 1901, less income-tax, be declared: and

(*d*) That a further dividend on the 40,000 ordinary shares for the half-year ended December 31st, 1901, at the rate of 4 per cent. per annum, less income-tax, be declared, and that the same be paid to all proprietors registered at March 14th, 1902.

This will absorb £13,318 0s. 1d., and leave a balance of £4,036 9s. 8d. to be carried forward.

The profits derived from the company's London stations have risen from £39,863 8s. 9d. in 1900, to £50,503 19s. 4d., in 1901, being an increase of 53·6 per cent. for the year. The total applications received at December 31st last amounted to the equivalent of 325,978 8-c.p. lamps, being an increase of 36 per cent. for the year, and the total units sold were 4,351,105, as against 2,990,138 for the previous year, being an increase of 45 per cent. The retiring directors are Mr. Frederick W. Reynolds and Mr. R. P. Sellon, who are eligible for re-election. The auditor, Mr. R. H. Marsh, also retires, and is eligible for re-election.

LONDON STATIONS.

St. Luke and Clerkenwell, Eastern Holborn, Western Holborn and St. Giles.—The balance to credit of revenue for the twelve months ended December 31st, 1901, amounted to £26,885 17s. 4d., details of which are given in revenue accounts Nos. 6, 8, and 10. In these districts the total applications to December 31st last, including power, represented the equivalent of 196,499 8-c.p. lamps, of which 173,704 were then connected to the mains. The applications for the year represented an increase of 53,304, and the connections an increase of 54,628. Included in above are 256 users of motors, aggregating 2,278 H.P. supplied from the company's mains, showing an increase of 1,107 H.P. for the year, and further applications have since been received, raising the total to 309 applications, representing 2,843 H.P. Additional generating plant for both lighting and power purposes has been erected during the year at the company's City Road station.

Wandsworth District (including the Parishes of Putney, Wandsworth, Clapham, Streatham, and Tooting), Camberwell, St. Olave, Bermondsey, and St. George-the-Martyr, Southwark.—The balance to credit of revenue for the twelve months ended December 31st last amounted to £23,618 2s., details of which are given in revenue accounts. Nos. 12, 14, and 16. In these districts the total applications to December 31st last represented the equivalent of 129,479 8-c.p. lamps, of which 120,130 were then connected to the mains. The applications for the year represented an increase of 32,872, and the connections an increase of 29,658. The work of laying mains in St. Olave, Bermondsey, is now completed, and current is available in the principal thoroughfares of that district. The additional plant erected at the company's station on the Wandle is now in working order.

The Bournemouth and Poole Electricity Supply Company, Limited.—The directors of this company have recommended the payment of a dividend on the ordinary shares of the company at the rate of 7 per cent. for the year ended December 31st, 1901, less income-tax, as against 6 per cent. for the previous year. The progress made by this company is very satisfactory.

The Dover Electricity Supply Company, Limited.—The directors of the Dover Company have recommended the payment of a dividend on the ordinary shares of the company at the rate of 5 per cent. for the year ended December 31st, 1901, less income-tax, as against 3½ per cent. for the year 1900. Since the close of the year the Dover Corporation have, subject to their obtaining the necessary borrowing powers, entered into an agreement for the purchase of this company's undertaking at Dover.

The Scottish House-to-House Electricity Company, Limited.—The provisional order for electric tramways at Coatbridge, granted to the company by the Board of Trade, was duly confirmed in the last session of Parliament. The work of remodelling the Coatbridge Station from alternating to continuous current, which was commenced last year in order to supply lighting, power and traction from one set of machinery, is now approaching completion. A supply of current will be available in Airdrie by the autumn.

United Alkali Company.

THE directors' report for 1901 states that the net profit is £230,346, and adding the amount brought forward, £60,167, less claims and law costs in connection with the explosion at St. Helens, May, 1899, £15,764, there is a total of £274,749. This, the directors propose, shall be apportioned as follows:—Interim dividend on preference shares, at 7s. per share for six months to June 30th, £93,527; final dividend on preference shares at 7s. per share for six months to December 31st, £93,115; transfer to "depreciation portion of reserve fund," £50,000, leaving an amount to be carried forward of £38,106. The directors consider that the year's profit of £230,346, which exceeds that of 1900 by upwards of £18,000, is satisfactory, in view of the high prices which have prevailed for fuel. The serious decline in the value of copper during the latter months of 1901 has also affected the balance-sheet adversely. The company's cyanide plant was completely destroyed by fire in June last. The loss has been recovered from the insurance companies. The plant has been rebuilt, and the manufacture is now proceeding as usual. During the year carbide of calcium has been added to the products manufactured by the company. An action for infringement of patent brought against the company by the Acetylene Illuminating Company has been successfully resisted, but the plaintiffs have given notice of appeal. The directors have no anxiety as to the result of this appeal, which has yet to be heard. The debenture holders, at a meeting held on June 14th, 1901, authorised an increase in the amount of debenture stock from £2,500,000 to £3,000,000, such increase to rank *pari passu* with the original issue of £2,500,000. This increase of debenture stock was required towards defraying the cost of additional properties acquired since the formation of the company, and for the general purposes of the business of the company. Of this authorised increase of £500,000, the sum of £201,880 has been allotted to debenture stock holders and shareholders of the company. Careful attention has been paid to the company's costs of production, with results that are very satisfactory when the high price of raw materials is taken into account.

Direct Spanish Telegraph Company.

THE directors' report for the year ended December 31st, 1901, to be presented at the meeting on Monday, March 24th, 1902, reads:—

The annexed accounts for the year ended December 31st, 1901, show, after providing for interest on, and redemption of, debentures, a balance to the credit of revenue of £9,705 19s. 9d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £14,705 19s. 9d., and the directors recommend the declaration of dividends for the year 1901, of 10 per cent. on the preference shares, and 4 per cent., free of income-tax, on the ordinary shares, amounting to £5,417 5s. 10d. Half of this amount was distributed on October 1st, 1901, as an interim dividend for the half-year ended June 30th, 1901. The dividends on the preference and ordinary shares will absorb the balance of the contingencies account, viz., £566 2s. 6d., and £145 3s. 7d. from the reserve fund. The traffic receipts show a decrease of £699 14s. 7d., as compared with the year 1900, which is entirely due to the cessation of traffic on the Barcelona cable during the interruptions mentioned below. The ordinary working expenses show an increase of £526 16s. 6d. as compared with the year 1900. As stated in the last report the Bilbao cable broke down close to the Spanish coast on December 27th, 1900. This cable was restored on January 23rd, 1901, and has worked well since. The Barcelona—Marseilles cable has unfortunately been twice interrupted during the past year: the first interruption, on January 6th, which was mentioned in the last report, having continued till April 7th, 1901. The delay in repairing this cable was due to unusually bad weather in the Mediterranean. The second interruption of this cable occurred on December 3rd, and was promptly repaired by the Eastern Telegraph Company's cable ship *John Pender* on December 16th, 1901, the interruption having lasted only 14 days. The cost of these repairs, amounting to £15,230 17s. 11d., has been taken from the reserve fund which was established for repairing and renewing the cables. The general offices of the company will be removed to Electra House, Moorgate, E.C., on April 7th, 1902. Sir John Denison Pender, K.C.M.G., is the director retiring by rotation, and offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election.

Bournemouth and Poole Electricity Supply Company.

THE report to be presented to the meeting to be held at Moorgate Court, E.C., on Tuesday, March 25th, at 2.30 o'clock, reads:—

The directors beg to submit their report and statement of accounts for the year ended December 31st, 1901. The capital expenditure incurred during the year in respect of the Bournemouth Provisional Order, 1890, and the Poole and Branksome Order, 1897, amounted to £26,246 14s. 4d. The balance from revenue account, together with the balance brought forward from last year, amounted to £15,665 3s. 7d., from which must be deducted interest charges, depreciation, &c., leaving the sum of £8,918 11s. 11d. to the credit of net revenue account, as against £8,052 10s. 5d. for 1900. Out of this sum the full year's dividend on the preference shares has been paid, and the directors now recommend the payment of a dividend on the ordinary shares of the company at the rate of 7 per cent. less income-tax, for the year ended December 31st, 1901. These payments will absorb £8,140 5s., and leave a balance of £778 6s. 11d. to be carried forward. The equivalent of 65,962 8-c.p. lamps were connected to the company's mains at December 31st last, showing an increase equivalent to 12,583 8-c.p. lamps connected for the year. The lamps applied for show an increase of 12,378 8-c.p. for the year, as against 10,498 for the preceding year. The company has been supplying power to the tramways between Bournemouth and Poole since the spring of last year, and terms have now been agreed for supply to the tramways about to be constructed from Bournemouth to Christchurch. The company's mains have been extended to Poole and Parkstone and to Winton during the past year. The work is practically completed, and a supply is now available in the principal thoroughfares of these districts. The progress made by the Richmond (Surrey) Electric Light and Power Company, Limited, during the past year is satisfactory. The directors of that company have declared a dividend upon its ordinary shares at the rate of 6 per cent. per annum in respect of the year ended December 31st last, as against 5 per cent for 1900. The retiring directors are Mr. Frederick W. Reynolds and Mr. F. E. Savory both of whom, being eligible, offer themselves for re-election. The auditor, Mr. R. H. Marsh, also retires, and offers himself for re-election.

London Electric Supply Corporation.—The report for the year ended December 31st states that the profit on the working for the year is £25,220, to which has to be added interest on deposit and amount brought forward, making a total of £25,274. Out of this the interest on debentures and temporary loan to December 31st, viz., £13,308, has been paid, leaving a balance of £11,966. The board propose to pay a dividend of 3 per cent. on the preference shares for the year ended December 31st, 1901; to place £3,000 to reserve account, and to carry forward £1,490.

A. & J. Stewart & Menzies.—The report for 1901 states that the net profit for the year amounts to £107,376. The dividend on the ordinary shares for the year was 10 per cent., and £15,000 has been placed to depreciation account, £50,182 being carried forward.

Eastern Telegraph Company.—Dividend at the rate of 6½ per cent. per annum on the pref. stock for quarter ending March 31st, and interim dividend of 1¼ per cent. on the ordinary stock in respect of profits for the quarter ended December 31st.

Prospectus. — Until twelve o'clock to-day (Friday) Messrs. J. S. Morgan & Co. are offering for sale £200,000 4½ per cent. mortgage debenture stock in the British Thomson-Houston Company at £104 per cent. The issue, the prospectus states, is made for the purpose of funding indebtedness incurred in connection with the Rugby works.

Robey & Co.—The report for 1901 states that after writing off £5,000 for depreciation, there remains a net profit of £20,446. The directors recommend a dividend of 10s. per share, amounting to £14,706, carrying forward £2,849.

Bell's Asbestos Company.—The result of operations for 1901 was a net profit of £16,825, and a dividend of 6 per cent. has been declared, £9,000 being placed to reserve.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending March 14th were £613; corresponding week last year, £604; increase, £9. Total to date, £6,203; corresponding period last year, £5,644; increase £559. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending March 15th were £203; corresponding week last year, £180; increase, £23. Total receipts to date, £1,724; corresponding period last year, £1,574; increase, £150.

Bristol Tramways and Carriage Company.—The receipts for the week ending March 14th were £3,996; corresponding period last year £3,842; increase, £154.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending March 7th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon *	797	586	—	9½	6,179	4,264	—
Devonport ‡	495	—	—	9½	3,568	—	—
Dudley—Stourbridge	661	139	—	9½	5,628	1,003	—
Gateshead ‡	647	—	—	9½	5,767	—	—
Greenock-Pt. Glasgow	415	241	—	9½	3,316	1,729	—
Hartlepool	178	7	—	9½	1,547	—	22
Kidderminster ..	95	9	—	9½	819	71	—
Merthyr ‡	211	—	—	9½	1,724	—	—
Oldham—Ashton ..	485	41	—	9½	4,164	—	61
Poole ‡	208	—	—	9½	1,626	—	—
Potteries	1,390	13	—	9½	12,412	270	—
Southport	141	26	—	9½	1,127	170	—
South Staffordshire†	757	52	—	9½	6,451	255	—
Swansea	413	64	—	9½	3,686	280	—
Taunton ‡	57	—	—	9½	474	—	—
Tynemouth ‡	206	—	—	9½	1,661	—	—
Wolverhampton Dist.	139	90	—	9½	1,101	687	—

* Partly horse. † Partly steam. ‡ Not in operation last year.

Central London Railway.—The receipts for the week ending March 8th were £6,782; corresponding week last year, £6,157; increase, £625. Total receipts to date, £72,895; corresponding period last year, £66,819; increase, £6,076. Miles open, 6.

City and South London Railway.—The receipts for the week ending Mar. 16th were £3,000; corresponding week last year, £2,028; increase, £972. Total receipts to date (11 weeks), £33,472; corresponding period last year, £22,226; increase, £11,246. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—The receipts for the week ending March 15th were £172 13s. 4d.; corresponding week last year, £156 18s. 1½d.; increase, £16 0s. 2½d. Total to date, £1,782 4s. 2d.; corresponding period last year, £1,689 19s. 8½d.; increase, £92 4s. 5½d. Miles of track open, 3. Car miles run, 1902, 5,082; 1901, 4,988. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending March 14th were as follows:—D.U.T. Co., £3,341 6s. 8d.; D.S.D. Co. £737 18s. 10d.; total, £4,079 5s. 6d.; corresponding week last year—D.U.T. Co., £3,168 18s. 6d.; D.S.D. Co., £711 3s. 5d.; total, £3,880 1s. 11d.; increase, £199 3s. 7d.; aggregate to date, £41,523 6s. 2d.; last year, £39,664 0s. 5d.; increase, £1,859 5s. 9d. Mileage worked 46.

Liverpool Overhead Railway.—The receipts for the week ending March 16th were £1,450; corresponding week last year, £1,574; decrease, £124. Total to date £15,059; corresponding period last year, £16,269; decrease, £1,210. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The near approach of another Stock Exchange settlement and of the Easter holidays, is circumscribing business considerably, and loud are the complaints as to lack of orders all round the markets. Moreover, as Budget Night draws near, the apprehensions with regard to fresh borrowing become more acute, and Consols in particular are dull even to weakness. Of course, the effect of this is noticeable through all the investment sections, and under the circumstances it is quite a relief to be able to point to the better tone developed by telegraph descriptions. The slump is, at least for the time being, arrested, and it takes very few buying orders to make a distinct change in quotations. Electrical Supply shares, after being rather harder, are generally lower on balance, and the second reading of the L.C.C. Electric Supply Bill has had a disturbing effect. The little Railway Market records a further relapse in Central London issues.

An interesting emission is that of the new 4½ per cent. mortgage Debenture stock of the British Thomson-Houston, offered at 104 by Messrs. J. S. Morgan & Co. To all appearance the interest seems fully secured, although there is less margin for repayment of the principal than there is for meeting the dividends. The stock becomes redeemable 10 years hence at 105 per cent. A merely nominal premium has been established in the market, but it is doubtful whether the outside public will get much of the stock, a large proportion of which was taken firm by insurance companies before the prospectus was published. There are several big "power" companies hailing from the North of England which will soon be inviting subscriptions for shares, and perhaps another borrower which may be with us again before long is the London United Tramways Company, the indomitable Mr. Clifton Robinson having succeeded in getting his company's latest Bill for extension passed by the examiner, Mr. Campion, last Monday. London United Preference shares are £1 premium and the Debenture Stock is about 2 to 3 premium.

In the electrical supply department, several of the leading shares have been quoted *ex* dividend since we wrote last, but in most cases the amount of distribution was easily recovered. Chelsea shares are a better market, despite the vapourings at the meeting about the shares going below par, and South Londons have a hardening tendency without any quotable change in price. County of London shares are not very bright, it being thought that the company ought to have written off more than it has done for depreciation. The same fault, it will be remarked, is to be found with the reports of the Notting Hill, Charing Cross, and the City of London Companies. London Electric Supply fail to retain their last week's rise; the appearance of the report has had no stimulating effect. The Metropolitan Company's meeting on Wednesday passed off without any particular incident calling for notice, and the shares might look cheap if one could only tell on what basis the arbitrators will assess the price to be paid the company by the Marylebone authorities for that part of the undertaking which lies in their district. As a speculative investment, however, South Londons at about 2¼ or 2⅜ have a decided attraction. St. James's have shed half-a-sovereign per share, and so have City of London Ordinary.

There is a demand springing up for several of the best Provincial Electric supply shares. Oxfords are wanted at 5½, Folkestones at £1 higher, and Winchesters (which are not quoted in the Stock Exchange Official List) at 5¼. Hove Electrics are steady at 7½. These provincialisms would be much more popular than they are if there were a freer market, and they make good investments as a rule, always provided that the companies chosen by the buyer of shares are under auspices which do not make a point of grossly over-capitalising their babies.

Electric Construction shares show no quotable alteration, but the close price is lower, consequent upon the dissensions on the board. Henley's and Callender's are both sticking at 18. British Westinghouse prices are 6⅛, 5⅞, and 1½ premium for Ordinary, Preference, and Debenture respectively, all for cash. Central London stocks continue on the downward track mapped out for them in these columns a month or so ago, and the Ordinary shows a loss of 4, and the Deferred of 1 per cent. this week. There are several Continental sellers in the market.

The telegraph market has grounded for the time, at all events. A few of its specialities display sharp upward reactions. Eastern Ordinary boasts a rise of five points, Anglo-American Preferred of one, and Eastern Extensions are 10s. up, this last being equivalent to the rise of 5 in Eastern Telegraph stock. Marconi scares are found to be overdone, and hardly so much as a tremor shook the market after the statement of Mr. Austen Chamberlain regarding the alleged agreement between the Cape Government and the Eastern Telegraph Company. This agreement, according to Sir Edward Sassoon, was to have the effect of excluding Marconi's system of wireless telegraphy from being tried and worked in Cape Colony, but it is stated that the Postmaster-General has no knowledge of any such agreement. Marconi shares languish at 3$\frac{15}{16}$.

Amongst miscellaneous varieties, Babcock & Wilcox have improved to 3 upon the company's securing a £60,000 order from the Metropolitan Railway for four dozen water-tube boilers in connection with the electrification scheme. National Telephones are inclined to ease off, especially the Deferred. South London tramway shares are 4 despite the woeful working of the past year. British Electric Tractions are without variation, except for a fall of 1 per cent. in the Debentures. Brush issues are very flat, perhaps indicative of the coming report, about which all kinds of surmises are afloat.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation March 12th.	Closing Quotations March 19th.	Business done during week ended March 19th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3⅛%	61s.	46 — 49	46 — 49	47⅜	46
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	88 — 90	89 — 91	91	90½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	7½— 7⅝	7½— 7⅝	7⅜	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	155 —165	155 —165	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 98	95 — 97	96⅜	95
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3¼%	...	9½— 10½	9½— 10½	10	9⅞
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	120 —130	125 —135	132½	125
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	84 — 87	85 — 88	86½	84
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	105 —109	105 —109	107½	105
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	12 — 13	12½— 13½	13½	12½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	99 —102	99 —102	99½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	8½— 9½	8½— 9½	9	8⅝
180,042	Do. do. 6 % Pref.	10	...	...	...	13 — 14	13 — 14	13⅛	...
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	27 — 29	27 — 29	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	37 — 41	37 — 41	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	½— ½	½— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
983,333	National Telephone. Pref. Stock	100	5 %	5 %	5 %	... — ...	95 — 99 xd	99	95
200,000	Do Pref. shares	2	...	3½	3⅜	... — ...	... — ...	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	... — ...	... — ...	62¾	61
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15 xd	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15 xd	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛xd	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	93 — 96	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	101 —105	101 —105	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's...	8	5 %	5 %	...	6½— 7½	6½— 7½	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	119 —125	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4⅜— 5½	4⅜— 5½	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —101	99 —101	100	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	12 — 13	12	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103	99 —102	...	...
88,321	West India and Panama Telegraph	10	⅝%	...	...	½— ⅝	½— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 5½	5 — 5½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½— 4½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅝— ⅝	⅝— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —105	100 — 105	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	8¾— 9¼xd	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	8¾— 9¼xd	8 13/16	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8½— 9½	9 — 10	9½	9 3/16
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5⅜	5 9/16
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	104 —106	104 —106	105¾	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5 — 5½	5 — 5½xd	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	110 —113	110 —113	111½	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	9 — 10	8 — 9 xd	8¾	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13 xd	12½	12 7/16
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	9½	9 1/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	13½	12 3/16
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	107 —110	109	108⅜
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6 — 6½	6 — 6¼	6 1/16	6¼
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6¼	6 — 6¼	6 1/16	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	106 —109	106 —109	108½	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½ — 11½	10½ — 11½xd	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅞— 2¼	1½— 2	1 1/16	1 1/16
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 5	4⅜	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	14½— 15½	15½— 16½	15½	14⅞
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14 — 15	15	14⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	101	100
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2½	1⅞— 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	2⅜	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11 — 12	11 — 12	12	11¼

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
¶Dividends marked ¶ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Mar. 12th.	Closing Quotation Mar. 19th.	Business done week ended Mar. 19th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4½— 5½	4½— 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	88 — 92	88 — 92	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13 — 14	13 — 14	13⅜	13⅛
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½— 12¾	12½— 12¾	12⅝	...
600,000*l*	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	126 —129	126 —129	128½	127¾
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	9½ — 10½	9½ — 10½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝— 6½	5⅝— 6½	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	18s. to 20s.	14s. to 16s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	19/6 to 20/6	16s. to 18s.	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½%	5 %	...	1⅜— 1⅝	1⅜— 1⅝	1⅝	1 7/16
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	101 —104 xd	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17½ — 18½	17½ — 18½	17½	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5 13/16	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	99 —102	101⅜	100
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	104½	103½
440,100	Do. do. Def. do.	Stock	...	...	4 %	99 —102	98 —101	98	...
855,000	City and South London Railway	Stock	1¾%	1¾%	2 %	65 — 68	65 — 68	68	66
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	78½	78
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	83 — 88	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅝— 1⅞	1⅝— 1⅞	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾— 10¼	9¾— 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	100 —103	100 — 103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	17½ — 18½	17½ — 18½	17½	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 6	5½— 6	5¾	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅜	21
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
87,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	1½%	5 — 5¼	5 — 5¼	...	...
10,000	† Do. do. Pref., £10 paid ...	10	5	...	...	11 — 11½	11 — 11½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½— 16½	15½—16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	37 — 40	35 — 38	36¼	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½— 11½	10½— 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	92 — 95	94⅞	92¾

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/16—3/16.
National Electric Free Wiring, 13/16—15/16.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, March 19th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	80/-	80/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a „ „ ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20	£20	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£81	£81	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£95	£95	..
a Shellac	per cwt.	127/-	127/-	10s. dec.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
j Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 3" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£71	£71	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g „ Rod	per ton	£71	£71	..
c „ Electrolytic) Bars ..	per ton	£68	£68	..
c „ „ Sheets ..	per ton	£75	£75	..
c „ „ Rod ..	per ton	£68	£68	..
c „ „ H.C. Wire	per lb.	6d.	8½d.	½d. dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	8/1½ to 8/2	3/1½ to 3/3	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	46/4½	46/8	3½d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	(£11 12 6) to £11 15)	£11 15	2s. 6d. dec.
g „ „ Sheet	per ton	£13 10	..	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	8/8 to 7/8	8/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£117 10 to £118 10	£117 to £118	10s. inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/6½	1/6	..
p White Anti-friction Metals —				
" White Ann " brand	per ton	£85 to £65	£85 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 8 lea. Flax	per lb.	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	4¾d.	4¾d.	..
j „ 10 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh'ts. (Vielle Montagne brd.)	per ton	£22 1	£2 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd e Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India Rubber, G.-P. and Teleg. Works g Messrs. James & Shakespeare, Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS. (MANCHESTER SECTION).

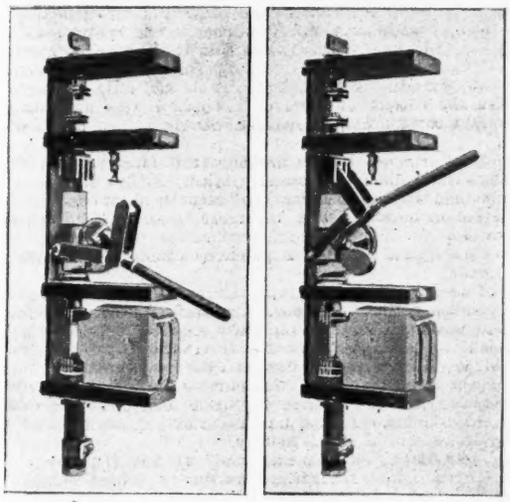
THE CONSTRUCTION OF HIGH TENSION CENTRAL STATION SWITCHGEARS.

By Henry W. Clothier, A.M.I.C.E., A.M.I.E.E.

(*Paper read February 1st*, 1902.)

(*Concluded from page* 445.)

Cellular Type.—This construction, better known as the Ferranti switch-gear, was first installed in Portsmouth in 1894, for 2,000 volts, and it has since been extensively and, indeed, for the last three or four years almost exclusively, adopted throughout this country on 2,000 and 3,000-volt single-phase systems. Referring to figs. 13



Switch open. Switch closed.

Fig. 14.—Section Through Alternator Panels.

[See Elec. Rev. for July 12th, 1901] and 14, it will be seen that the framework consists of a number of heavy slabs of insulating material grouted into the station wall and protruding therefrom. The spaces between them are divided off into a number of cells by vertical division plates, also of insulating material, made to slide into grooves cut in the horizontal slabs. Porcelain insulators are mounted deep into these cells or recesses which carry the high tension conductors and several metal fittings for receiving the switches, fuses, instruments, &c.

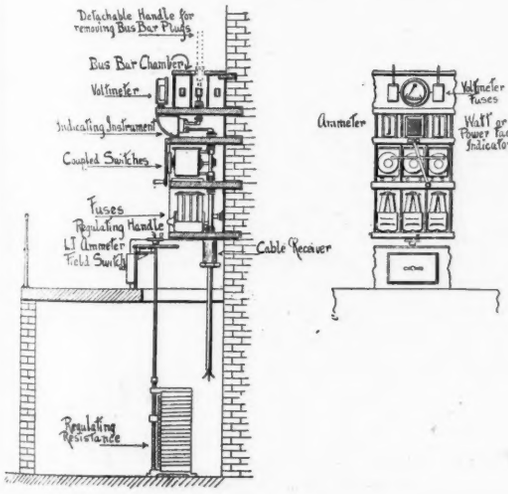


Fig. 15.—Cellular Type Switch Gear.

This arrangement entirely eliminates the space at the back common to the types before mentioned. While all the connections and conductors are visible, and easily traced from the front, they are so shielded by the cellular construction of insulating material that it is, to all intents, impossible to make accidental contact with any two metal parts of differing potential at the same time. Moreover, the constructional framework is made up of non-inflammable material without resorting to a metal frame, thus affording great advantages both as to insulation and immunity from fire or accidents due to shocks. Thanks to this security in design, the record of this type of switch-gear has not been marred by the occurrence of any serious or fatal accident. This is striking evidence when one considers that there are more cellular-type high-tension alternating current gears working in this country than all other kinds totalled together.

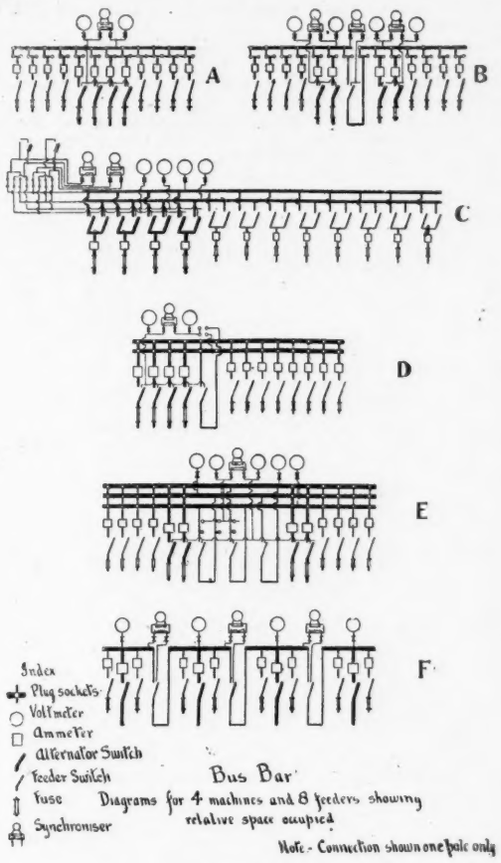


Fig. 17.*

Fig. 15 shows a section through a 3,000-kw. three-phase generator panel. The bus bars will be seen at the top. Each panel is furnished with a plug by which it can be readily isolated. All high-tension instruments, switches, and fuses are made to plug into contacts, and fixed in such a way that they can be quickly

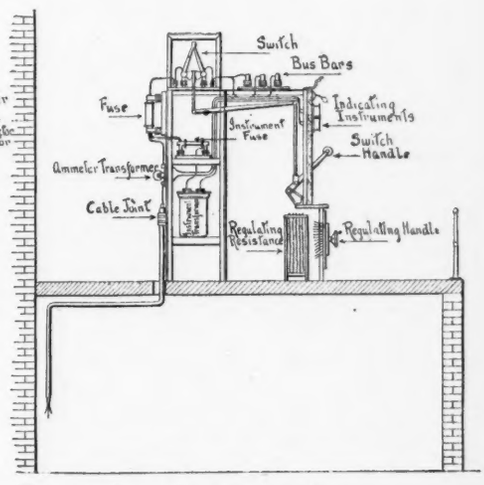


Fig. 16.—Multiple Frame Type Switch Gear.

withdrawn even while the rest of the apparatus is "live." On all feeder panels the fuses are provided with duplicate contacts for this purpose. The drawing shows the position of the regulating table, field switch, exciting current ammeter, and resistance, which are mounted separately, but in a line with the high-tension panels.

* For references see our "Notes" columns.—Eds.

Another feature of this construction is the absolute absence of cable connections between the various components, and the mechanical means adopted to replace them; each high-tension part is contained in a complete cell, and so divided from any other part of differing potential.

This concludes the description of the various constructions. There are, of course, others invented and used for alternating current switch-gear, but the foregoing are typical of the most important generic designs which have been tried and put to practical use.

Bus Bars.—Complexity must inevitably give way to simplicity in all apparatus. In no part of a central station is this axiom more applicable than in the arrangement of the bus bars, which form the foundation of the connections. Numerous ingenious and complicated methods exist, involving the duplicity of parts, multiple bus bars, change-over switches, cross connections, and other elaborate provisions which seem to allow for every emergency. However, simple as they may be made to look on paper, in practice they tend

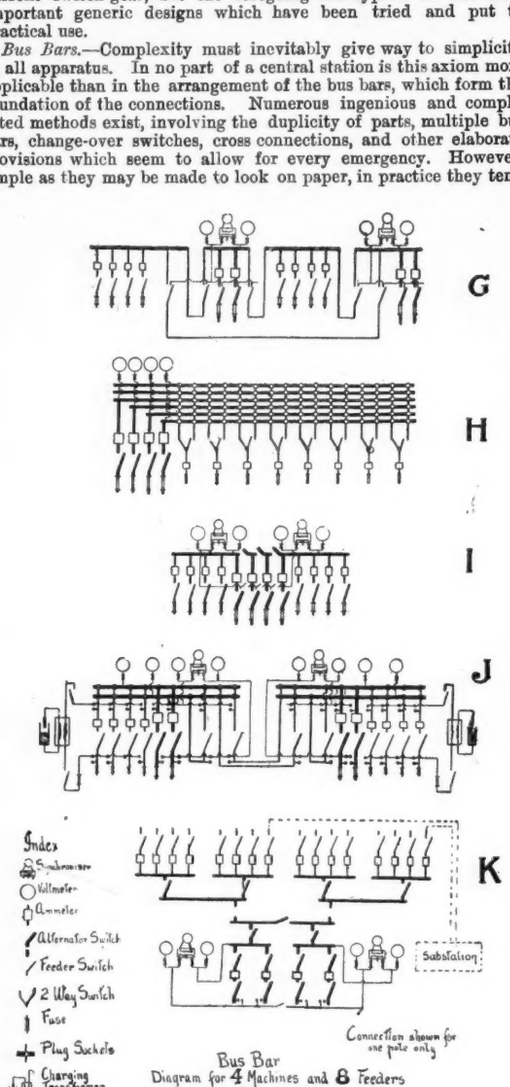


FIG. 18.*

to increase the difficulty of supervision and chances of mistakes. The confusion may be modified by complex systems of interlocking devices, but for perfection in design these should be unnecessary. There should be no alternative ways of operating any part. Given one way, the attendant cannot go wrong. For this reason alone, irrespective of the many other advantages, such as economy in running, uniform distribution of the load, &c., it is preferable to parallel all generators to one common set of bus bars. The arrangement of bus bars has such an important bearing upon the switch-gear construction, that it is opportune to consider some of the other methods, as illustrated by diagrams on figs. 17 and 18, which, to save a repetition of lines, have been drawn to represent the connection of one pole only. The network involved by them on three-phase systems can be imagined. Each diagram represents the high tension connections for four generators and eight out going feeders. It is interesting to note from them how a simple construction can be converted into a complicated one.

PART II.—COMPARATIVE NOTES ON BRITISH AND GERMAN SWITCH-GEARS.

In these notes it is not the intention to criticise, but to assemble the main features and essential points of difference in general design, in order that fair conclusions may be drawn from them, and from the discussion, which the author hopes may tend to improve not only the imported material, but also the productions of this country. It must be understood that the methods of Germany herein mentioned are those which appeared to predominate among the extensive works and supply stations visited during the recent tour of the members of this Institution. It is only natural to conclude that the works exemplified the most modern and approved methods. The standard of British designs considered will be the cellular type which has been installed in the majority of stations in this country.

Fig. 15 and 16 have been drawn to the same scale to represent a comparison of the typical switch-gears of both countries. The views are intended to illustrate a 3,000-KW. generator panel for a three-phase system at about 6,000 volts.

General Construction.—In this respect the description in the first part of this paper will point decisively to the fact that whereas, in this country, great endeavours have been made to render all parts of the gear visible and yet inaccessible by accident, in Germany the aim has been to attend only to the safety of the front portion of the construction. The gears are of the type with backs, and are designed on the "flat-board," "basement" and "multiframe" principles; bare bus bars are usually mounted on insulators without any form of covering, and no attempt is made to shield other live fittings which are mounted at the back. The intermingling of these fittings with the metal framework is the converse of the policy taught by our experience, which is to have no back and to avoid the use of metal framework near high tension conductors. Moreover, the absence of straggling cable and strip connections between the component parts of the gear is very apparent on the cellular construction as compared with the foreign boards with backs.

The Space Occupied by the switch-gear is often an important consideration in planning a central station. In this respect it is worth noting, that the "cellular type" occupies about one-third the floor space as compared with the other types, and for the same number of machine, circuit and inter-connecting panels, about two-thirds the length of platform required by a well-designed "multi-frame gear."

Switches.—In Germany the main switches are invariably operated from handles projecting through the marble fronts. Oil-break switches contained in cast-iron boxes are used, but the general practice is to use those designed to open with a slow movement, allowing an arc to draw out, flare and die away gradually, on the principle of the Siemens & Halske lightning arrester. This method is also directly contrary to the principle of quick-break devices for suppressing the arc, and the more efficient oil-break switches which have proved successful in this country.

The high-tension fuse most extensively used in Germany is not unlike the well-known Bates fuse, consisting of an open-ended tube of porcelain, ambroin, stabilit or similar insulating material, with plug terminals at each end. The fuse wire of copper or alloy is threaded through the tube and clamped by screws and plates or soldered to the terminals. For potentials of 2,000 to 10,000 volts the length of these tubes varies between 8 in. and 15 in. Several fine wires are connected in parallel for the higher voltages, each wire being enclosed in a separate internal tube or otherwise partitioned by insulating material, so that each wire has a column of air to itself. Unlike the Bates fuse there is no handle moulded with the tube, but flanges are provided at the ends, and moreover, in most cases, it is customary to have a long pair of wooden tongs close by the switch-gear with which any fuses can be clutched while the operator is at a safe distance from it. Considering the massive tube fuses used at Deptford and Willesden, which are from 4 to 5 ft. long, and also the expensive designs, such as the oil-break fuses of home manufacture, it would appear that either we over-estimate the destructive effects caused in breaking high-tension circuits, or else the necessity of blowing a fuse without destroying the fuse holder is not considered as a matter of importance in Germany. The variation in size and initial cost of the respective designs is very pronounced.

It is very common in German practice to construct high-tension switchboards without fuses or automatic devices of any kind in circuit with the alternators, and to have plug fuses on the out-going feeders, but no switches on these circuits. The fuses in such cases are placed in cellars or in basements away from the station attendants. There is thus no way of breaking a load on a feeder circuit other than by blowing its fuse. The visible switch-gear in these stations is only that required for the control of the machines whilst under normal conditions. We were informed in one important station in Berlin that one man was never sent alone into the cellar or basement but, for safety, was always accompanied by another to look after him.

There are many points of difference in the instruments used on high-tension switch gears. Electrostatic voltmeters, almost universally used in this country, give way in Germany for electro-magnetic or hot wire voltmeters connected to the secondaries of transformers. But in a few instances where electrostatic instruments are used, it is instructive to us to note that the cases are made of insulating material, and the difficulty, common to alternating current systems, of sparking over, due to rises in potential, has been obviated by covering the fixed cells with a layer of insulating material such as mica shellaced over, thus forming an efficient insulating shield between the cells and the moving vane. For further protection a resistance is connected in series with the fuses. Unlike our Kelvin, and Ayrton & Mather voltmeters, the German electrostatic instrument is not usually fitted with a spark gap. The scales, however, of these instruments—taken collectively—are not so open and boldly marked as on our patterns. Accustomed as we are to our long range voltmeters and ammeters, of both dial and edgewise patterns, the instruments in common use in German central stations appear to us somewhat small, and the scales seem to require close inspection to read them.

All possible means whereby connections and apparatus can

* For references see our "Notes" columns.—EDS

the constructional framework is made up of non-inflammable

* For references see our "Notes" columns.—Eds.

be reduced, without affecting the utility of the whole, should be taken advantage of. With this in view there is something to the credit of the home designs in the method of using one common synchroniser, and incoming machine voltmeter, instead of complicating the system by using separate synchronising transformers and voltmeters for each machine. As an example of the former, the Ferranti method is to make contact automatically with a common synchronising bar (or pair of bars for multi-phase system) while the main dynamo switch is in a "half-cock" position. This arrangement has the advantage of simplicity in construction and also in working, as compared with the latter method which entails the provision of separate plugs or switches on each machine panel.

There are many other details of more or less importance where the best switch-gear practice of the two countries differs, such as the method of connecting to the bus bars and of isolating panels by the use of bus bar plugs, the provisions for receiving cables, and for removing instruments and other parts of the gear safely and quickly without the use of special tools. These details have perhaps been more carefully dealt with in our best British designs, than has been considered necessary in Germany. On the other hand, we may have to learn something concerning the methods of economy in design and production by which passable results can be obtained by a minimum expenditure in material and labour. But it is difficult to know where to draw the line in cutting down material and cheapening designs, because it is of such vital importance that, for apparatus on which so much depends, the efficiency must not be sacrificed for economy in design.

To sum up, the main and great difference rests on the principles of construction; the details follow in sequence, and are, to a certain degree, dependent upon them.

Conclusion.

It will form a fitting conclusion to this paper to consider, without taking up too much time, the absolute requirements for one of the common systems of transmission. The single-phase switchgear has become practically standardised, but the three-phase switchgear for 6,000 to 10,000 volts introduces many problems for discussion.

The first question to decide is the bus bar arrangement. The diagrams on figs. 17 and 18 show many methods, but of these, provided the switchgear is reliable, there is none more suitable than the simplest (represented in diagram A) for any number of machines of modern design. There are, however, cases where it may be deemed advisable to split up the station plant into sections. For example, in this city it is proposed to run one set of generators on the traction load and another set on the lighting load. It would be interesting to know what effect the fluctuation of the traction load would produce on the lighting load if the two systems were run in parallel, assuming that motor-generators or rotaries, convert the high tension alternating current to a divided continuous current supply for the consumers. It is quite possible that there is no need to have separate high-tension traction and lighting bus bars at all; then it will be more economical and convenient to run every machine on to one common set of bus bars, means being provided so that any generator or feeder panel can be readily isolated for adjustment, repairs, or cleaning purposes.

With a balanced load only one ammeter is essential on a three-phase panel, but provision should be made to enable this or other ammeters to be used occasionally for reading the current on any or all three phases.

There is no doubt that it is the best practice to supply fuses with duplicate contacts to each phase on the feeder panels. But for generators the conditions are different; with two or three alternators running in parallel, fuses have sometimes given trouble by opening the circuit of all the machines when a fault has occurred on one only. Reverse current automatic switches have been made to meet this objection, but complications are involved thereby, which introduce an element of uncertainty in action under emergencies. Another way of dealing with the question is to have no fuses or automatic devices on the generators. Modern alternators will stand a short for a few minutes, or at least for sufficient time to blow the feeder fuse, if the fault is on the mains, or if the fault is on the generator, to enable the attendant to isolate the defect.

Machine and feeder switches must be of a selected pattern which will open circuit without enabling a rise in potential to occur, and without causing injury to the switch contacts when used for breaking, not only the rated capacity of the circuit, but the more severe conditions to which they are likely to be subjected when emergencies occur. It must be remembered that tests which have been carried out in this country, and on a larger scale with higher voltages in America,* show that the maintenance of an arc in open air, even for a short period, is liable to produce resonance effects, and high voltage oscillations, equal to two or three times the normal potential of the system; whereas it would seem from tests carried out at the same time, that excessive rises in potential are not experienced with oil-break switches. Spark gaps which will arc across when the pressure rises above the normal, can be fitted to the bus bars or to the cable, but the switch-gear should be constructed to avoid the necessity of these devices, which are likely to irritate the system, and reduce the degree of safety by bringing conductors of differing potential close together on one apparatus.

The capacity of the feeder cable has an important bearing on the design of feeder switch-gear, due to the rise in potential occasioned by switching on and off a long length of main with capacity. Charging devices which will operate in conjunction with feeder switches are necessary in such cases.

* Recorded in a paper read by E. W. Rice, Junr., before the American I.E.E., Buffalo, August 22nd, 1901.

We have not had much experience with power factor indicators, but provided a reliable instrument can be obtained to read the lag or lead of an alternate current supply, it would be a serviceable, though not essential, addition to the feeder panel, in that it would to some extent communicate to the central station the condition of the load and the regulation of the motor-generators at the sub-stations.

With regard to recording or registering wattmeters, the simplest practice is to mount them between the feeder and generator bus bars so that they will register the total energy generated by the entire plant. Indicating wattmeters can be mounted on the generator panels in the same way that the power factor indicators are attached to the feeder panels (see figs. 15 and 16). But given reliable ammeters, it is not difficult to estimate the output of the alternators near enough for all practical purposes, and so where initial cost is of moment both indicating wattmeters and power factor indicators can be dispensed with.

The generator panels have obviously to include sychronising devices, and a regulating table containing field switches, field current indicators, and regulating resistances. It is only necessary to add the bus bar voltmeters, and possibly a panel for an auxiliary motor-generator, to fulfil the principal requirements of a complete three-phase central station switch gear.

In view of the general tendency towards standardisation in the designs of any apparatus manufactured and used throughout the world for one common purpose, it is evident that many designs at present in vogue will disappear in favour of a switch gear which will be the outcome of the experience to be gained in the immediate future. On what lines will the switch gear of the future be based? The author hopes this paper will evoke suggestions that will help to solve this problem and so be a guide to our switch gear designers.

INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE SECTION).

ELECTRIC POWER SUPPLY ON THE NORTH-EAST COAST.

By C. S. Vesey Brown, M.I.C.E., Member.

(Paper read March 10th, 1902.)

Amongst the many engineering problems which have, during the last few years, engrossed the attention of members of this Institution and kindred societies, there are none which may be said to have the same magnetic attraction for both the professional and lay minds as "electrical power supply." It is firmly believed, and, as the author thinks, rightly so, that the adoption of electricity as the motive power in all the thousand and one applications for which power is required in the manufactories of this country, will do a great deal towards enabling the owners of these factories to compete successfully against the very strong bid which has been made by the American and Continental manufacturers for the supply of manufactured iron and steel goods in what has hitherto been looked upon as the sole market for British manufacturers. It is probable that the competition has been less severely felt in the district upon which your attention is more particularly directed to-night, but, nevertheless, signs are not wanting that the time must surely come when certain of the industries associated with the districts in the neighbourhood of the Tyne, Wear, and Tees, will require careful attention to prevent any strong attack by the foreign manufacturer.

The author's intention in presenting this paper is to awaken interest in the question of electrical power supply, as much in the direction of the equipment of the necessary power stations as in the possibilities which lie before their successful instalment, from the point of view of their ultimate requirements, and he asks the indulgence of the members for a brief retrospect of the history of electrical power supply in this country. When Parliament passed the Electric Lighting Acts of 1882 and 1888, it was thought by the general public, and, indeed, by many engineers, that the possibilities of electric power supply were limited to a radius of two, or at the most, 3 miles from the generating station. At that time, what may be called the alternating-current branch of the profession were working hard at the development of high pressure alternating currents, with a view to the transmission of single-phase currents over distances varying from 5 miles to 20 miles radius from the central station. One of the earliest, if not the earliest, experiments in this direction was in 1890, at the Grosvenor Gallery station in London, where, by coupling the trunk cables between that station and Deptford in series, a line of between 13 and 14 miles was interposed between one of the alternators used as a generator to drive the second alternator as a motor, the latter being used in its turn to drive through shafting and belts four horizontal single-crank engines. The loss on the line was about 40 per cent., 2,500 volts being the initial pressure, but the motor ran perfectly in synchronism, and it was proved beyond a doubt that power could be transmitted over this length of line. The members of the Institution are sufficiently well aware of the subsequent discoveries of polyphase alternating currents, and the possibilities which were opened up by these improvements on single-phase generators.

Owing to the difficulties which Parliament had placed in the path of the investor who wished to construct works to supply, under statutory regulations, electrical power over considerable areas in this country, it was not until the year 1900 that any power supply undertakings were authorised; and one had to look abroad for examples of high-pressure long-distance transmission of electrical

power, with the solitary exception of the Deptford undertaking, the pioneer of all the extra high pressure power stations. But it is now possible to say that several power stations have been established on a large scale, and this brings the subject of the paper into closer prominence, for one of the works referred to is that established and in operation at Wallsend; and it may, perhaps, be more correctly termed a "power station" than the others at work in London, the Midlands, and Lancashire, in that it is largely used for power supply to the engineering works on the north side of the Tyne.

In the areas on the north-east coast over which statutory rights have been granted to supply electrical power, and the areas for which powers are being sought in this session of Parliament, practically the whole of the coalfields of Northumberland and Durham are contained, and the extensive iron ore district known as the Cleveland District of Yorkshire is included. The companies which have obtained Electric Power Acts are the Cleveland and Durham County Electric Power Company (1901) the County of Durham Electric Power Company (1900), the Walker and Wallsend Union Gas Company (1900), and the Newcastle-upon-Tyne Electric Supply Company, Limited (1901), and the Bills in Parliament for session 1902 are those promoted by the Newcastle-upon-Tyne Electric Supply Company, Limited (Extension of Powers), and the Northumberland Electric Power Company.

In this area there are, apart from the works established or authorised under Tramway Acts and electric lighting provisional orders, no less than 11 authorised power stations, to be increased to 13 if the powers sought for this session are obtained, and there are approximately 350 collieries, and, excluding small works requiring under 100 H.P., upwards of 1,000 miscellaneous works, including engine and boiler works, shipbuilding yards, chemical works, saw-mills, brickyards, quarries, iron and steel rolling mills, foundries, breweries, dry docks, flour mills, and many other manufactories and works using power of one sort or another. There are also about 100 miles of tramways and light railways, and the North-Eastern Railway system with its connecting mineral railways, and, in addition, there are approximately 150,000 inhabited houses within the 33 authorised distribution areas. From an approximate estimate of the power used in several of the typical works the author considers that the power required to supply the above would not fall far short of 400,000 H.P., and allowing a reserve of 25 per cent. in the plant, machinery to the extent of 500,000 H.P. would be required. In taking into account the probable conversion of the railway system for electric traction, the author is of opinion that the time is not far distant when the whole of the railway systems in this and other countries will be operated by electricity. A commencement in this direction is being made on the Metropolitan Railways in London, and powers are being sought in this session of Parliament to adapt electric traction on at least two authorised existing railways, now operated by steam (one in England and the other in Ireland). From whatever point of view the question is looked at, it is not difficult to show that electrically-operated railways will eventually give greater satisfaction to the users of the line, and to the stockholders whose capital is invested therein, than the present arrangements. Smaller trains and a more frequent service will be the result, with an equivalent increase in the train mileage and passengers carried. No better example of this can be given than the successful running of the tube railways in London. It does not, of course, follow that the division of the above 500,000 H.P. by 11 or 13 stations is an indication of the size of each power station, as undoubtedly the bulk of the power will be required along the banks of the three rivers mentioned; and as there are already in the district some 18 stations (13 for lighting and power, three for lighting, power, and traction, and two for traction only) equipped and in operation with a total of about 33,000 H.P., and with room for expansion beyond the amount, it is not unreasonable to suppose that at least 350,000 H.P. would be required in the power stations, which allows an average of, roughly, 30,000 H.P. per station. In the author's opinion this is properly divisible into two small sets of 3,000 H.P. each and four sets of 6,000 H.P. each. There will always be a considerable amount of power required on Sundays, holidays, &c., such as pumping, hauling, and similar work in collieries, repair works in engine works, shipyards, dock pumping, and traction, &c., which should readily require 3,000 H.P. in each district; and it would be advisable in equipping the stations to arrange that intercommunication is made between each on the trunk mains, in order that separate stations may be stopped down when required on Sundays, holidays, &c., and in this manner the economy in generation will be preserved.

The type of equipment required for these power stations is a matter upon which little can be said here, but one ventures to express the opinion that at no distant date the steam turbine will be a strong competitor for first place in the equipment, especially in view of the very marked economy at full load and overload which was demonstrated in the recent experiments at Elberfeld. It remains for the advocates of this particular form of steam generator to press forward its claims against the reciprocating engine equipped with poppet or Corliss valve gear. The question of steam generation should also receive careful consideration, and one cannot overlook the enormous amount of heating power which can be derived by combining the waste blast furnace and coke oven gases with efficient water-tube boilers. The combination of blast-furnace gas and the boilers in a generating station of 30,000 H.P. should be able to allow an economy of production which is hard to beat with coal-fired boilers. The use of gas engines of large power is strongly advocated by many, but beyond powers of 1,000 H.P. or 1,500 H.P. the gas engine maker has not yet shown that it would be possible to equip an electrical power station with units of 4,000 KW. to 5,000 KW. The system of distribution along the trunk mains should undoubtedly be by three-phase alternating currents. It is difficult to agree with the arguments which have been advanced in favour of two-phase supply. For example, the increase in the copper required for the latter system for the trunk mains would be a very considerable item in the capital expenditure for each undertaking. When a single-phase alternating system is in use, and it is considered necessary to convert the system to polyphase, it may be advantageous for the time being only to duplicate the mains, but as the business expands the result can only be in one direction—viz., to burden the undertaking with additional capital upon which interest has to be earned, and consequently higher prices charged to the consumer—for there can be no economy in the generation charges in a two-phase system over a three-phase generating station. Those responsible for undertakings similar to that established at Wallsend, where single-phase alternating currents are being displaced in favour of three-phase, are to be congratulated on having taken the right step in abandoning any idea of two-phase generation in favour of three-phase.

The relationship of periodicity to the phase question is of considerable importance, and upon this point there appears to be a divergence of opinion and practice. Primarily the power station is equipped to supply power only, and in the course of time "power supply" will be the bulk of the business carried on, but it is not expected that lighting will be entirely disregarded, and though the greater portion of this will be done by continuous currents transformed through rotary converters from the original alternating current, there still remains the possibility of lighting by alternating currents transformed through the ordinary transformers. The author is inclined to the adoption of 40 periods as a standard, unless the supply is entirely for power purposes, when probably 25 periods is better. On this point a suggestion is made at the end of the paper which it is hoped will bear fruit, and will settle the standard periodicity for the district.

(To be continued.)

THE RICKS ACCUMULATOR.

A LEAD accumulator devised by A. Ricks, of Berlin, appears to be a considerable advance on what has previously been achieved, especially as regards lightness and durability. Some tests with this battery are described in the *Centralblatt für Accumulatoren-elementen und Accumobilenkunde*, Vol. iii., p. 29, and previous articles have appeared in the same journal, Vol. i., pp. 404 and 405, and Vol. ii., pp. 11 and 12; the German patents relating to this battery are Nos. 116,413, 116,469, and 116,470.

The active material is cemented on both sides of a plate of celluloid, vulcanite or other suitable non-conducting material. The material is so firmly attached to this carrying plate that it will stand considerable shocks without being loosened. The material was found to adhere well, even after the battery had been in use for a year; and the usual reduction of the quantity of active material and consequent reduction of capacity, which takes place in most accumulators, was in this case avoided. A further advantage of the

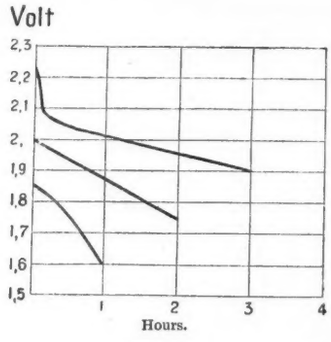


FIG. 1.

Ricks construction is that the active material can be made of any required thickness; plates have been made with coatings varying from 1 mm. to 30 mm. in thickness. Very thin coatings permit of more rapid charge and discharge but have a small weight capacity; thick coatings if perforated with a large number of holes have a much greater weight capacity. The method of attaching the coating to the non-conducting plate enables it to be perforated without reducing its durability.

The conductor which takes the current from the active material is a piece of thin sheet-lead which is wrapped round the external surface of the active coatings. One continuous piece of sheet-lead bent into the proper form serves for the positive plate of one cell and the negative plate of the next, so that no soldering or other artificial connection is required. The active material is contained between the non-conducting carrying plate, and the enveloping lead-conducting plate. The inventor alleges that his accumulator occupies only about half the space of an ordinary accumulator of the same capacity.

The following are the data of experiments that have been made with the Ricks accumulator:—

American I.E.E., Buffalo, August 22nd, 1901.

undertakings were authorised; and one had to look abroad for examples of high-pressure long-distance transmission of electrical

1. In the first experiment a battery consisting of three cells was employed. Each cell had only one positive plate and one negative plate; the electrodes were about 4 to 4½ mm. thick, with a height of 195 mm., and a breadth of 160 mm., the celluloid carrying plate being ½ mm. thick. The positive electrode was wrapped in a

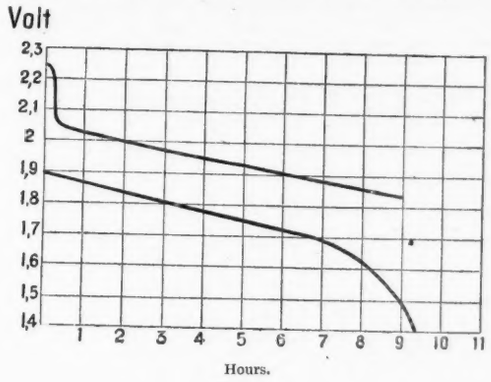


Fig. 2.

perforated lead plate of ½ mm. thick, while the lead plate on the negative electrode was perforated with 42 rectangular openings each 15 mm. by 25 mm. The dimensions of a cell were 170 × 250 × 14 mm. The following are the weights of the constituent parts:—

Celluloid containing vessel	0·140 kg.
Two celluloid carrying plates	0·050 „
Spongy lead	0·380 „
Peroxide of lead	0·380 „
Lead conducting plates	0·350 „
Sulphuric acid 20° Beaumé	0·500 „
Vulcanite springs for insulation	0·030 „
Total ...	1·830 kg.

On the second discharge, after the plates had been formed, the results shown by the curves, fig. 1, were obtained. The discharge was made with a current of 5 amperes. There were two breaks in the course of the experiment, the first lasting 3¾ hours, and the second 1 hour. The total amount of energy obtained from the cell was 30 ampere-hours at an average pressure of 1·9 volts.

2. Experiments were then made with cells containing comparatively very thick electrodes. The dimensions of one plate were 160 × 190 × 30 mm., the other plate being only 22 mm. thick. The following are the weights of the constituent parts in a cell with only two electrodes.

Negative electro-decoating	1·800 kg.
„ „ lead plate and celluloid carrying plate	0·550 „
Positive electrode coating and carrying plate	1·800 „
Positive electrode lead plate	0·550 „
Celluloid containing vessel	0·200 „
Vulcanite springs	0·050 „
Acid	2·200 „
	7·150 kg.

The discharge is represented by the curves in fig. 2. On the first day a current of 7·5 amperes was taken off, and on the following 6 amperes. Altogether 130·65 ampere-hours were obtained, the average pressure being 1·8 volts.

3. A battery of two cells each with three plates was tested. In each cell was a positive plate 16 mm. thick, and two negative plates each 8 mm. thick. The total weight, including the acid, was 6 kg. The dimensions of the cell were 170 × 250 × 55 mm. The discharge was made with 12 amperes on two successive days; 140 ampere-hours at an average pressure of 1·85 volts were obtained. This amounts to 43·2 watt-hours per kg. of the total weight, inclusive of acid. The density of the acid at the end of the discharge was 18° Beaumé. The temperature of the room in which the discharge took place was 12°—14° C.

4. Finally, a battery of two cells each with five plates was tested. The following are the weights of the constituent parts:—

One celluloid box (170 × 250 × 80 mm)...	0·200 kg.
Five vulcanite-carrying plates at 50 g. ...	0·250 „
Lead-conducting plate	1·500 „
Spongy lead	2·200 „
Peroxide of lead	2·200 „
Vulcanite springs	0·150 „
Acid	3·200 „
Total ...	9·500 kg.

The thickness of the plates was 2 to 7 and 3 to 12 mm. The discharge was made with a current of 11½ amperes on three successive days. 230 ampere-hours were obtained at an average pressure of 1·9 volts, corresponding to a total of 437 watt-hours, so that 46 watt-hours were obtained from 1 kg. of the total weight.

The type of cell, of which the tests are given under 1, has been in practical use for a considerable time at different places, and has proved very satisfactory.

Some experiments were made by cementing active material of other substances than lead on the carrying plate. Spongy antimony, for example, was tested; but neither this nor any other material gave such good results as lead. The capacity, the tension, and efficiency of the cell with such materials appears to be always considerably less than that of the lead cell.

A NEW MERCURY-JET BREAK.

The interruptors of induction coils to be used for exciting X-ray tubes must fulfil two principal requirements: (1) They must make the highest possible number of breaks per unit of time, and (2) they must be capable of interrupting comparatively large currents without sparking. Leaving out of account the electrolytic breaks of Wehnelt and others, the only breaks which have hitherto satisfied the above conditions are the mercury jet breaks. The principle of these breaks is well known, but may be shortly indicated as follows:—

Either the mercury is projected out of a fixed nozzle against a rotating contact piece, or it is projected from a rotating nozzle against a fixed contact piece. Tesla, who patented a break of this

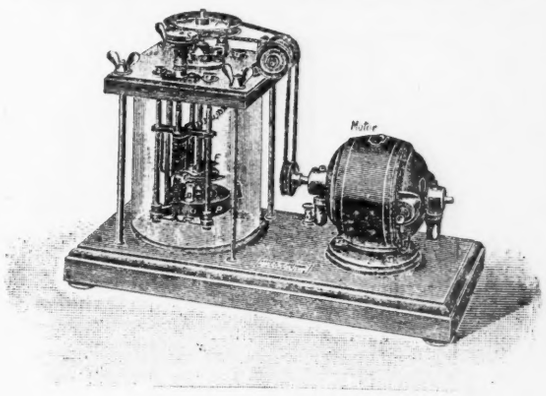


Fig. 1.

kind in 1897, appears to have been the first to publish a description of this invention, and his apparatus belonged to the category of breaks with rotating contact pieces and a fixed nozzle.

A new form of the mercury-jet break manufactured by Reimger, Gebert & Schall, of Erlangen, is described in the *Elektrotechnische Zeitschrift*, of February 6th, p. 107. In this apparatus both the

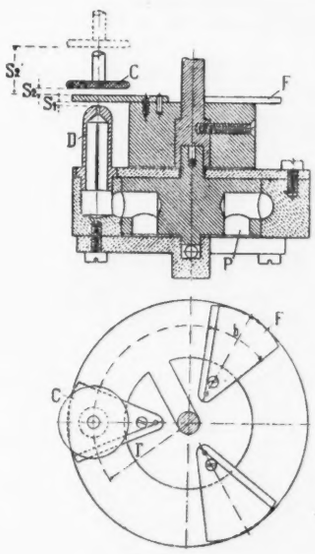


Fig. 2.

nozzle and the contact plate are fixed, and the break is effected by insulating arms which pass between the two.

Fig. 1 shows the external form of the apparatus, and fig. 2 shows in section and plan the principal details. The glass containing-vessel is filled with mercury up to the bottom edge of the nozzle,

and above the mercury alcohol or petroleum is poured in to fill the containing vessel almost to the brim.

The centrifugal pump, P, is driven by an electromotor and band passing over guide pulleys as shown in fig. 1. This forces the mercury out of the nozzle in a strong continuous jet which impinges against the contact plate C. The plate is connected to an external terminal by a bare conductor on which are strung a number of glass beads to prevent contact with the metallic framework of the apparatus. The contact plate can be raised or lowered by turning the nut S on the lid of the containing vessel, a spiral spring co-operating with the nut to effect the movement in both directions.

This adjustment of the contact plate is made use of to regulate the duration of the closure of the circuit. A little explanation will be necessary to show how this result is attained. Let us suppose that the rear edge of the insulating arm has just passed off the jet; then a certain time, depending on the velocity of the jet and the distance of the contact plate must elapse before the jet reaches the contact plate and closes the circuit. This time must be subtracted from the time required by the following arm to reach the jet and re-break it. It is evident, therefore, that if the velocity of the jet remains constant, the duration of the closure of the circuit is changed by changing the distance of the contact plate.

The mathematical statement of the above explanation of the operation of the jet is as follows:—

Let s_1, s_2, s_2^1, denote the distances indicated in the upper half of fig. 2.

b the breadth of a rotating arm where it cuts the jet.

z the number of the arms.

r the radial distance of the aperture of the nozzle from axis of rotation of the arms.

n the number of turns of the break per minute.

The total number of breaks per minute is—

$$U = n\,z$$

The time in seconds of closure of the circuit between two breaks is approximately—

$$t = \frac{\frac{2\,\pi\,r}{z} - b.}{\frac{2\,\pi\,r\,n}{60}} - \frac{s_2}{v}.$$

This assumes that the velocity, v, of a particle of mercury is practically uniform between the nozzle and the contact plate. As a matter of fact, it diminishes slightly on account of the action of gravitation, but the change is so small that it may be neglected.*

From this we see how the time of closure is changed by altering the distance, s_2, of the contact plate.

If sufficient adjustment cannot be obtained by the movement of the contact plate the number of rotating arms can be changed.

As is well known, a coil can be worked with a higher E.M.F. if the time of closure is reduced. As an example of the capabilities of the break, let us suppose that the applied E.M.F. is 220 v. Then if a break with six arms is driven at 1,500 revs. per minute, there will be $6 \times 1{,}500 = 9{,}000$ breaks per minute, which will suffice to prevent injury to the coil.

The apparatus is so constructed that the petroleum or alcohol is not set in rotation by the rotation of the pump. This prevents the depression of the surface of the insulating liquid, which in breaks of this kind often gives rise to explosions.

Owing to the high speed of this break, the X-ray tube in the secondary circuit of the induction coil gives a soft steady light, and as in the case of all mechanical breaks the loss of electric energy is less than with such breaks as the Wehnelt.

WIRELESS TELEGRAPHY AND SUBMARINE CABLES.

By E. GUARINI.

I propose in this article to discuss Mr. Mervyn O'Gorman's idea, viz., that the *coherer* might render valuable service to submarine cables. The advantages of the *coherer* (it might be better to say *imperfect contact*, as there are also *anti-coherers*) in the above-

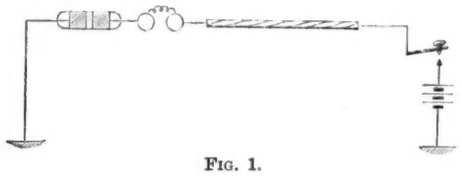


Fig. 1.

mentioned connection, would lie in the great sensibility of this little apparatus, this special eye, sensitive to an invisible light, the electro-magnetic waves. This sensibility is 10^{-14} of a watt, whereas in an ordinary relay it is 10^{-6}.

* The formulæ given in the article in the *Elektrotechnische Zeitschrift* are incorrect, and the results obtained altogether erroneous.

The employment of such a sensitive apparatus as the imperfect contact would enable submarine cables to realise all or some of the three following advantages:—(1) An increase in the speed of transmission, which, as we know, depends on the sensitiveness of the receiving apparatus. (2) A diminution in the electromotive force required, which, according to the case in question, would increase the safety of the insulating material in existing cables, and would enable this insulating material to be reduced in new ones. (3) A

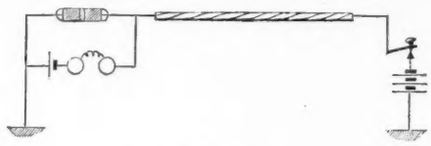


Fig. 2.

diminution in the section of the conductor by a reduction in the current required for the receiver. The simplest mode of applying the imperfect contact to submarine cables is that indicated in fig. 1; at the transmitter the cable is brought to the earth through a key and a battery; at the receiver a very sensitive relay is connected to earth through a coherer, which becomes conductive when a difference of potential, say, of 2 volts, is applied to its terminals.

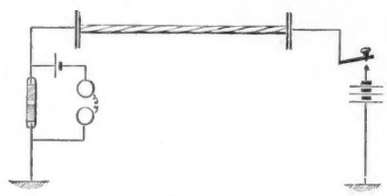


Fig. 3.

One of the terminals of the coherer is at the potential of the earth: we will call this zero. When, on closing the key the other terminal of the coherer is brought to a potential of 3, for instance, the coherer (for the sake of brevity we will continue to use this term, with the reservations mentioned at the beginning of this article) will become conductive (since $3 > 2$) and the relay will be influenced.

This arrangement is merely theoretical. In reality the current which acts upon the coherer, is the same in intensity and electromotive force as the one working the relay. Hence it is the same thing as suppressing the coherer.

We must therefore adopt the arrangement shown in fig. 2; the relay with a local battery is put in shunt at the terminals of the

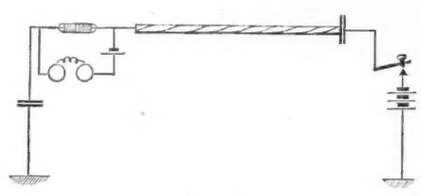


Fig. 4.

coherer. It is seen that while an extremely feeble current will be sufficient to act upon the coherer, the relay is worked by the local battery. In fig. 3 we see what happens to the arrangement when the cable is cut by condensers.

In order to lessen to a very great extent the effect of the earth currents on the coherer, the arrangement shown in fig. 4 may be used: the condenser, at the receiving end, is placed between the coherer and

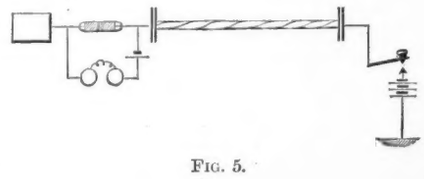


Fig. 5.

the earth. In order to entirely suppress these disastrous effects (earth currents) we should avail ourselves of the arrangement shown in fig. 5, in which the connection to earth, at the receiver of fig. 3, is replaced by a suitable capacity. Fig. 6 shows the arrangement of the double stations—*i.e.*, the ordinary arrangement—diagrammatically, in which the coherer (with a battery and a relay, or a recorder such as a recording siphon in shunt) takes the place of the ordinary receiver. In order to screen the coherer from the influence of the

electro-magnetic disturbances produced on the opening and closing of the key, the coherer and its connections (fig. 4) are enclosed in a suitable metal sheath (see ELECTRICAL REVIEW,

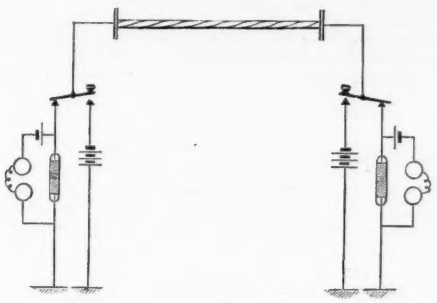


FIG. 6.

July 12th, 1901). In the normal state the circuit of the receiver (fig. 7) consists of two earth connections, the coherer and its connections, the key, a relay or a recorder and one cell of the battery of the transmitter. When transmission is taking place, the coherer on the one hand, and the relay or any apparatus substituted for it on the other, are put out of circuit.

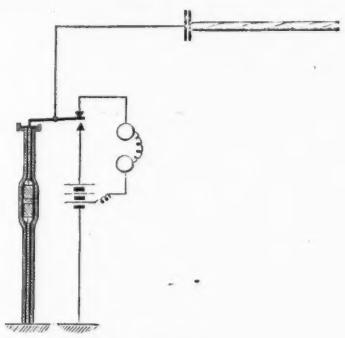


FIG. 7.

In order to obtain the raising of the pressure in the circuit of the coherer and to effect the sending of connected signals when a dash is transmitted (up to the present we assume the transmission to be effected by dots and dashes) we use the arrangement shown in fig. 8. In the normal state the fine wire circuit of the induction coil (provided with an interrupter for the transmission) is in circuit with a coherer, a relay (or other apparatus) and one element of a battery. The thick wire circuits of the two induction coils at the two stations are on *open circuit* (English patent 1,555—1900, ELECTRICAL REVIEW, January 11th and 18th, 1901), although it is

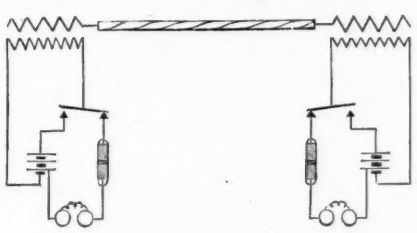


FIG. 8.

a case of low frequency (in the case before us the capacity—that of the cable—is very great). The arrangement shown in fig. 9 is a modification of the arrangement in fig. 8; on the one hand the coherer is protected by a metal sheath, on the other the free terminals of the thick wire circuit of the transformers are connected to earth through condensers.

If we stop at the arrangements above described, we cannot hope to obtain very high speed of transmission unless we have recourse to multiple-communication. One cause of the high speed of transmission in submarine cables and landlines also is due to the use of short signals alternately positive and negative. With a coherer it would at first sight seem difficult to realise this, *i.e.*, a selection of signals according to the sign of the current. But we will try to arrive at it in a somewhat roundabout way by using two coherers. This is the principle of our method:— If we have two coherers working for a difference of potential, x, if we bring one of the terminals of one coherer to the potential $+ a$, and one of the terminals of the other coherer to the potential $- a$, if we bring the other terminals of the two coherers to the potentials $+ b$ and $- b$, and if we fulfil the two conditions:—(1) $x < (\mp a) - (\pm b)$; (2) $x > (\mp a) - (\mp b)$, according to the sign of the current received, one or the other of the coherers will be influenced; by a special arrangement of circuits and the use of a suitable apparatus, the nature of the current can be discerned by means of a local battery. The coherers then act as two selecting relays.

Fig. 10 relates to one of the modes of applying the above principle. The line wire is divided at B. (1) It is brought to earth through a galvanometer; (2) It is brought to earth through a coherer, one terminal of which is brought to the potential $- 2$ by a battery; (3) It is brought to earth through a coherer, one terminal of which is brought to the potential $+ 2$ by a battery. The two coherers work for a difference of potential of 3. If by a transmission of positive current the two terminals of the coherers connected with the line wire are brought to the potential $+ 2$, the left hand

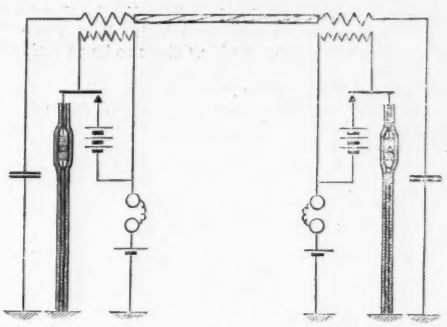


FIG. 9.

coherer will act, since the difference of potential between its terminals is 4, whereas, the right-hand coherer will not act, since the difference of potential between its terminals is 0. The needle of the galvanometer will deviate, say, to the left. On sending a negative current through, and observing the same conditions, the right-hand coherer will work, and the left hand will not; the needle of the galvanometer will deviate to the right.

The above principle, and the arrangement shown in fig. 10, can also, be it understood, be applied to wireless telegraphy. In fact, the arrangement in fig. 10 is really a wireless telegraphy arrangement, since the sending of the current is effected by induction between the plates of the condensers. Perhaps, therefore, it will be expedient to abandon, for the time

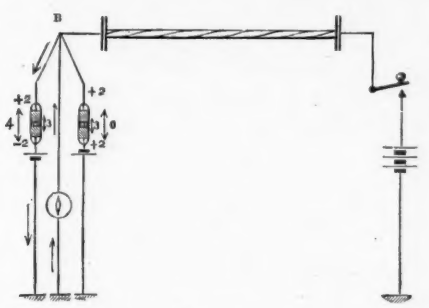


FIG. 10.

being, the Hertzian waves, and depend on the low frequency waves produced by alternating or intermittent currents (ELECTRICAL REVIEW, June 7th and 28th, July 12th, 1901; English patent 1,555, 1900).

Perhaps some very ingenious inventor will succeed in doing with one coherer what we are doing with two. Well, there will be no harm in that. On the contrary, so much the better. We shall always welcome any fresh advance, and we shall not say that wireless telegraphy is a step backward when it is an undoubted advance on what has been done.

(To be concluded.)

TUNBRIDGE WELLS TELEPHONES.

(Continued from page 448.)

MR. J. W. FORSTER, the borough accountant, who was next called, said the statement that he had prepared showed that the actual income from 533 revenue-earning lines, at £4 11s 5d. per line, was £2,437. This was based on the actual receipts for the period between August 1st and January 30th, but on subsequent experience it had risen to £4 12s. 2d. He had calculated the revenue from 615 additional lines at the same rate as the average earning of the lines in actual working. Taking the comparative annual expenditure

on the £25,000 outlay and the £19,300 outlay, he had not allowed more for management, office salaries, or wages, but had increased the expenditure for operators by £120. He had advanced rent, rates, and taxes, &c., by £138. He had not increased the terminal fees because he did not think it at all necessary. He was of opinion they would be earning terminals instead of paying them away. The statement was the estimated income and expenditure on an estimated outlay; there were no actual figures. Though the rates were payable in advance, they had, in many cases, not been paid. He mentioned that from eight call offices the actual receipts were about £30 for the six months.

Asked by Mr. Drury as to whether any material alteration was made in the wages and various items between the end of November and the end of January, the speaker said that there was, and it was in the direction of increases in manager's and assistant manager's salaries.

In the course of further examination of Mr. Forster, Mr. Bennett's figures in the Eastbourne estimates were dealt with. The estimate put in by Mr. Cripps was stated by Mr. Cripps to be an estimate for one year's working.

Mr. Robb: If you have the proper proportion of spare lines the estimated profit disappears. If you knock off 25 per cent. from the 1,148 lines you only have 161 revenue-earning lines instead of the number you are estimating revenue from?—About that.

If you only have 861 revenue-earning lines, instead of 1,148 lines, that would knock the bottom out of this beautiful estimate?—Oh, certainly; you would not spend the money.

In every properly conceived telephone system, you must allow for expansion?—Yes.

If that be so, and you have only 861 revenue-producing lines, your estimate disappears—the profit is gone. Were you present at the meeting of the Council when it was decided to apply for the loan?—Yes.

The meeting of the Council was not an ordinary meeting. It was a meeting called to discuss an Isolation Hospital?—Yes.

The Council meeting was held in committee so that the ratepayers do not know the discussion.—The telephone matter was sandwiched in, and I objected.

Mr. Cripps: The matter was not considered in public, as it was of a private nature. On the motion of Mr. Robb, I take the formal objection. Mr. Robb is not entitled to use his position here as an advocate to raise a question upon what was done on his own motion.

Mr. Robb: I quite agree. I say the matter was rushed, and I wrote objection as we only received our agendas the day before.

Mr. F. W. Stone, on behalf of an independent body of supporters, said he attended without any suggestion from the Town Council, of which he was a member. Those whom he represented came forward voluntarily to support the application in the strongest possible manner. They felt that as the license had been granted to the Corporation, and a loan of £10,000 also sanctioned, this further loan, part of which was already spent, should also be sanctioned. It was not part of his duty to defend the estimates; he would leave that to the Corporation, whose desire was to make the scheme a self-supporting one. He did not believe in municipal trading. At the commencement of the scheme he objected to it, but as it had been entered upon, it was the duty of the ratepayers to support their undertaking, and make the scheme a success.

Mr. Warner, on behalf of Mr. Drummond, who, on general principles, objected to the proposals of the Corporation, said he preferred to wait till the Post Office provided facilities, and they had one complete system instead of the nuisance of different sets of poles in narrow country lanes.

Mr. Paul Bevan, F.I.C.A., practising in Leadenhall Buildings, E.C., auditor to the Great Eastern Railway, and of the firm of auditors to the borough of West Ham, and auditors to numerous companies, was next examined by Mr. Drury. He had looked at the two statements purporting to be accounts of income and expenditure of the telephone undertaking, prepared by the borough accountant. Having heard the explanation of the borough accountant, he found the statements of accounts were merely estimates, and could not be properly described as accounts, as they were not on a cash basis. He would not sign such a document himself, without a considerable amount of qualification. He should describe it merely as an estimate, and not a statement of accounts.

The Inspector: It was put before me as partly an estimate.

Witness said he should expect to find insurance, depreciation, and similar items in a complete statement.

Mr. Drury: I suppose you are prepared to accept Mr. Foster's figures of £1,550 sinking fund and interest; it will mean correcting your figures by a small amount?—Certainly.

How do you arrive at the next item—management, staff, &c.?—I took that from the statement prepared by Mr. Bennett in his report to Eastbourne on the actual working of Tunbridge Wells.

For rent you have adopted Mr. Forster's figures, and also for maintenance, inspection, Corporation charges, &c.?—Yes.

With regard to depreciation and renewals, where did you get that from? Is that from Mr. Bennett's figures?—That is also referred to by Mr. Bennett in his Eastbourne report.

Your figures are all taken from Mr. Bennett and the borough accountant, and give an actual loss of £1,413 5s. 3d., less the difference between £1,687 10s and £1,550?—That is so.

That is adopting all the figures of the other side?—Yes.

Mr. Snowdon, A.M.I.E.E., gave detailed evidence regarding defects which he had found in the construction of the system; the poles were very light, and there was a general absence of stays. The work is not carried out satisfactorily in all ways. The insulators are all Mr. Bennett's, and he found them in many places used for terminals. With regard to the Exchange he found a multiple switchboard, but no multiple. The wiring of the switch-room seemed to have been done very hurriedly, and not finished off properly. With regard to the overhead work he should include wind storms and snow storms as a contingency likely to cause considerable damage. He should consider that three inspectors would be necessary considering the size of the area.

By Mr. Cripps: Assuming he was employed to lay down a telephonic system, where probably only 300 subscribers would be obtained, and laid down a cable with sufficient wires for that number, and spares up to 1,100, he would consider that sufficient.

The inquiry was resumed on Friday, the 7th inst.

Mr. Snowdon, cross-examined by Mr. Cripps, said he came down on Monday, and devoted about three hours to examining the country part of the municipal system. He considered that he formed a good idea of the principal routes—whether they were substantially constructed or not. At any rate, he saw plenty in the time to form an opinion. He did not count how many poles he found insufficiently stayed. He spoke from general observation. He considered general examination quite sufficient to form an opinion. His evidence was based on what he had seen. He continued his examination on Tuesday and Wednesday, and went back to town each day. On Wednesday he visited the switch room, but he noticed other defects as he went about the town. He devoted an hour to the switch room. He spoke over the system and found a certain noise over the line, but could not say whether it was local or general. When he spoke through it was satisfactory. As regards the transmitter used at Tunbridge Wells, he had not examined the inside of it. It was Swedish. It was not the instrument used by the Post Office.

Mr. Cripps (after consulting Mr. Bennett): Are you sure of that?

Mr. Robb: We have evidence on that point.

Witness repeated that Mr Cripps was inaccurate in assuming that the instrument used at Tunbridge Wells was adopted by the General Post Office. Taking everything into consideration, he should not choose the Bennett insulator. He had no experience in his practice of the Bennett insulator. He should not condemn an installation for using a Bennett insulator, but as a terminal insulator he should certainly condemn the Bennett insulator. He was not prepared to say whether the defects he found were the fault of the contractor.

The Inspector: He has not seen the whole system.

Mr. Robb: If he had, his evidence might be still more serious as to the amount of defects.

Witness said he considered there should be a multiple switchboard. This was the general practice. He would have put the multiple board in in the first instance to save the expense later on. His experience was that that would be the best course. He did not consider the Tunbridge Wells system a substantial one. Would not condemn the whole system, but it was not so efficient as it might be. It was not only defective in construction, but in the principle of working. If a subscriber forgot to press the button it upset the whole communication. The system by which subscribers were put in communication was not equal to the National. He was not aware that the "press the button and ring the bell" system was used in Glasgow by the National for their cheap service. The general instrument used by the National had only to be lifted up and replaced. The National telephone he used in Tunbridge Wells was entirely automatic, and that gave it a great advance in convenience to subscribers.

Re-examined by Mr Drury: He did not pretend to have made an exhaustive detailed examination. In a general look round he saw quite enough to form an opinion as to defects which would affect the efficiency of the line in some degree. The defects he saw might be small in themselves, but their cumulative effect must be considered. Work done in a rush meant a lot of expense in keeping it in order later on. Hurried work must affect efficiency. The crossing system adopted locally was probably adopted because it was the cheapest. The £300 deducted from the contractor would not be enough to make the whole system efficient in this respect. He had never seen the Bennett insulators used as terminals anywhere except on this system. He saw several instances of cables insufficently protected.

By Mr. Robb: He was in Tunbridge Wells three days.

Mr. Cripps: Parts of days.

Mr. Robb: Do you know that Mr. Bennett reported on the whole system of Europe after one day in Belgium?

Mr. Bennett: No.

Mr. Robb: And one night. An old hand like Mr. Bennet can form an opinion in one day of Europe that my witness may not form of Tunbridge Wells in three days.

The Inspector: I can form my own opinion of the sufficiency of the examination.

Mr. J. E. Kingsbury, M.I.E.E., was examined by Mr. Drury. He saw from the accounts presented that all the 1,148 lines were put in as revenue-earning to arrive at the income. That was impossible. The lines could not be all revenue-earning, because of the necessity for spares. The minimum of non-revenue-earning lines should be 25 per cent. in an exchange, and he should therefore deduct 25 per cent. from the estimated income. When an exchange was in operation it could not be worked efficiently without spares. Subscribers might want to be transferred to other lines, and this could not be done without spare lines in every cable. He considered that switch rooms at 3s. per week was a very low estimate. He thought that it would be found unremunerative, and that removals would occur. That would be a serious expense. He certainly considered a depreciation fund necessary. His experience was that

since 1879 telephone plant had been replaced three times. That would mean the whole plant piece by piece.

By the Inspector: Any system to-day was not more than 12 years old in its entirety. There was continual modification. He did not suggest the whole thing—lock, stock and barrel, would be done at one time, but it would have to be replaced in 10 or 12 years' time.

By Mr. Drury: It would not be impossible for Mr. Bennett to re-model his switchboard as he said he could, but it would be unwise. A patched-up switchboard would not work well, and it was better to put in a new switchboard altogether, and place the old one in another exchange. It was a very delicate organism, and it needed all its parts to work together with great accuracy.

Mr. Drury: The Municipal cannot do that.

Witness, continuing, said the time had arrived when that should undoubtedly be done. He differed entirely from Mr. Bennett that multiple switchboards were being abandoned. The comparison Mr. Bennett made between Tunbridge Wells and San Francisco was an impossible one. The depreciation fund was unquestionably necessary because without replacements the system could not be kept in working order. The history of the past taught them what would be probable in the future. They might go on darning a stocking, but they must put aside money to buy a new one in time.

The Inspector: Of more fashionable design?

Witness: If you want an up-to-date system it involves that. They wanted very large profits if an exchange was to be maintained in efficiency. He did not agree with Mr. Bennett that telephone exchanges always made a profit. He could only speak of the Tunbridge Wells system from a general knowledge, and he hesitated to say to what extent depreciation should be allowed for, but he should say 7½ per cent. should be allowed for depreciation besides maintenance.

The Inspector: On capital expenditure?—Yes, for depreciation only.

The Inspector: Is that intended to include what I alluded to as the new fashioned stocking?—Yes.

Continuing, he said Mr. Bennett's allowance of 2 per cent. for maintenance and inspection was also insufficient; he should put it at 5 per cent. Depreciation and maintenance must both be provided for future contingencies if the exchange was to be efficient. He did not agree with Mr. Bennett that as the exchange grew the payment by the Corporation for terminal fees would be extinguished; on general principles he thought the payments by the Corporation on behalf of their subscribers would increase rather than diminish. Subscribers would be called up on the National system where possible, because the National had no terminal charges to pay like the Corporation had. On the other hand, the outgoing calls would be on the Corporation system because the Corporation paid instead of the subscribers. Therefore, the balance would always be against the Corporation. He also disagreed with Mr. Bennett as to one cell being sufficient. A transmitter which would only permit the use of one cell was entirely unsuited for trunk line work. A great defect was the switchboard and the loss of time by operators. The conduit system cost more in the first instance, but it was more economical for future working. He did not agree with Mr. Bennett that snowstorms were so exceptional. The experience was a serious storm doing considerable damage every seven years—when they did come they really worked havoc—and slighter storms at more frequent intervals. A fire at a house might mean the collapse of an overhead system by the collapse of wires.

By Mr. Elvy Robb: Under the head of contingencies an allowance ought to be made for withdrawal of wayleaves and replacing poles. In an overhead system of 1,100 subscribers a considerable allowance ought to be made for contingencies. As a telephone system grows so the rapacity of owners in charging for wayleaves increases. It was the practice for roofs to be kept in repair in exchange for wayleaves.

Witness said as regards terminal fees the conditions in Glasgow would be similar to Tunbridge Wells as regards competition. If Glasgow were paying the National Company five times the amount they received for inward calls that was a serious item they might expect to be repeated against the Tunbridge Wells Corporation. As regards spare wires, if an insufficient allowance were made, it would mean continually pulling up the roads. There must be a fair proportion of spare for new business and changing of lines. They could not tell what circuits new business would come on. He considered that Mr. Bennett's calculation by percentage was not reliable. It was not an accurate basis to go upon in reckoning expenses. The proper basis would be to take the mileage of wire and the number of poles, ascertain the rates of maintenance, and make an estimate based on previous experience.

By Mr. Cripps: He had never laid out a telephone system, nor had he ever had any experience of working one. He did not know what the National Company allowed for depreciation. He simply gave his own experience of what depreciation should be. As regards the Corporation having to repay its loan, he knew there was a difference of actuarial opinion whether this was equivalent to depreciation, but he looked at it as a practical engineer. To put it in a practical way, the Local Government loan was to be repaid at the end of a certain period, with the idea that the property or concession, or whatever it may be, became the property of the locality at the end of that period. Then one should have a sinking fund and depreciation as well. If it is understood that the plant is to be renewed by obtaining a fresh loan, one may leave out one or the other.

Mr. Cripps: We have no power to continue the business after 25 years. We are bound to hand it over. We simply repay to the mortgagees the loan obtained.

Witness: Do you say they are obliged to buy your plant at the end of a given period, but not obliged to pay for it?

Mr. Cripps: Oh, yes; all effective plant.

Witness: Of which they are the judges.

Mr. Robb: The Tramway Companies' terms. It will be a scrap-iron price.

The Inspector: The G.P.O. will not buy the system as a revenue-earning concern?

Witness: If the system is not maintained, and the Post Office only buy such plant as is effective, it means a serious difference.

Mr. Robb: Mr. Bennett's Eastbourne report is interesting on that point.

Mr. Cripps: We cannot go into that.

Witness, continuing, said the progress of telephony in Tunbridge Wells was not unparalleled. The lowering of the National rate conveyed to his mind the idea of competition. It was an ordinary business proceeding. If the competition ceased, the rate would probably go up. They might expect the National rate to go up if the Corporation system were defeated, but they would not have to pay two subscriptions to both exchanges. He did not agree with Mr. Bennett that the deficiency of spares could be remedied by superimposing. It meant a very delicate operation, and he did not know of any case of such a thing being done on subscribers' lines at all. He was not aware it was done at Cardiff. It might be done on junction lines, and that to a very small extent.

By Mr. Drury: He knew nothing personally of the working of the National Company. He studied their balance-sheets from a business point of view. He could not make any accurate comparison of the National Company's depreciation fund, because they put by a reserve for reconstruction. They had a reserve of one million out of eight.

Mr. Cripps: Invested in what?

Mr. Robb: In their own undertaking. Some of the Corporation undertakings have their reserve in that way. I have objected to it strongly.

Witness said he expected lowering rates with competition. It depended how long the competitors could stand it.

By Mr. Robb: The working expenses of the National Company per line exceeded the revenue earned by the Tunbridge Wells lines by 10s. per line. That was without any capital charges, but simply the working expenses per line. That was the average all over the kingdom for the National Company. The revenue at Tunbridge Wells per line showed a deficiency of 10s. per line as compared with the National cost of maintenance. As to the increase in the number of subscribers locally, he assumed that there would be a rush to anyone who gave £1 for 15s. Perhaps people would not believe they were getting £1 for 15s. He was not aware that Mr. Bennett had stated at Eastbourne the opposite to what Mr. Cripps said as to the Post Office purchasing the plant. Mr. Bennett put the value of the plant at the end of 25 years at ½ per cent. He doubted if it would be worth ½ per cent. It would depend how much of it had been replaced. If the plant were not replaced it would not be worth ½ per cent. He considered the sinking fund was to relieve the ratepayers of debt, and that depreciation must be provided separately.

Mr. Cripps: The business ceases with the licenses. The Postmaster-General says so.

Mr. Robb: When Mr. Bennett contradicts that he knows better than the Postmaster-General.

The Inspector: I do not think Mr. Bennett would put his opinion against the Postmaster-General.

Mr. Robb: But he has done so.

Mr. Cripps read the terms of the license that the Post Office would buy the plant.

Witness: The plant or the effective plant?

Mr. Cripps: I am summarising the terms of the license. Any difference in opinion as to the worth of the effective plant is to be decided by arbitration.

The Inspector: I hope we shall finish the inquiry to-day.

Mr. Robb: The fact is the Corporation adopt an exceptionally favourable position of doing business on the security of the rates.

Witness said the ratepayers ought to have a return for their undertaking, if business principles were adopted.

Mr. Drury: That is the case so far as my client is concerned.

The Inspector then asked formally whether there were any ratepayers present who wished to be heard. No one coming forward, the Inspector remarked they appeared to be satisfied with their representatives.

Counsel having replied, the hearing was concluded. Our report of counsels' speeches will appear next week.

CURRENT SPECIFICATIONS.

XCIV.—WIGAN EXTENSION PLANT.

SUMMARY.

Extent of Contract.—Supply, delivery and erection of one 425-KW. steam dynamo upon prepared foundations, and the specified steam-pipe and switchwork.

Type of Engine.—Alternative tenders are invited for dynamos of tenderer's make directly coupled to Willans & Robinson or Belliss engines.

Specified Speed.—Not to be less than 250 revolutions per minute, or exceed 300 revolutions per minute.

Steam Pressure.—160 lbs. per sq. in.

Economical Load.—Valves to be arranged to give most economical load at four-fifths of the normal full load.

Normal Loads.—As lighting set 425 KW., permissible maximum emergency load 470 KW. As traction set 390 KW., permissible maximum emergency load 470 KW.

Specified Variation of Speed.—Governor to be arranged that the speed may be varied 30 per cent.

Fly-wheel.—A heavy fly-wheel suitable for traction purposes is to be provided, and to be bolted directly on to the spider of the armature.

Dynamo.—To be of multipolar type, with not more than twelve or less than six poles.

Temperature Rise.—The armature or field magnet circuit must not rise more than 70° F. above surrounding atmosphere when carrying normal full load current continuously.

Steam Consumption.—When tested at engine-maker's works, with 160 lbs. steam, working condensing, not to exceed:—At full load, 15½ lbs. per I.H.P.-hour; at three-quarter load, 16 lbs. per I.H.P.-hour; at half-load, 17 lbs. per I.H.P.-hour.

Superheat.—Tenderer to state whether engine will work satisfactorily with steam superheated 120° F.

Condenser.—A Korting No. 34 ejector condenser to be fitted to steam dynamo.

Steam Piping and Valves.—To be supplied as specified.

Switchboard Extension Apparatus.—To be supplied as specified.

Specified Date of Completion.—Six months from date of order.

Penalty for Late Delivery.—£1 per working day.

Specified Terms of Payment.—Up to 80 *per cent.* of contract price during construction and on delivery on site, 20 *per cent.* three months after satisfactory completion.

Stipulations as to Removal of Foreman.—None.

Stipulations as to Wages to be Paid to Workmen.—The rates current in the district in which the work is done are to be paid.

Period of Maintenance.—Three months after date of completion.

Arbitration Proposals.—See comments.

Date for Receipt of Tenders.—March 24th, 1902.

This specification has been prepared by Mr. H. Collings Bishop, the electrical engineer to the Corporation, the plant now required forming an extension unit to that now in operation.

The technical requirements are clearly stated. The engine is specified to be either of Messrs. Willans & Robinson or Messrs. Belliss & Morcom's make, and tender forms are forwarded with the specification to permit of alternative offers for these different engines to be made. The steam consumption guarantees should be reached by either type of engine, and the question is asked whether the makers will guarantee satisfactory working with 120° F. superheat.

It is interesting to note that the rated normal full load when working as a traction set is lower than when working as a lighting one, so as to allow a higher percentage overload and yet attain only the same maximum emergency load output. The condenser is specified to be of Korting's ejector type, and spaces are left in the specification for schedule prices of all steam pipe and switch work items to be given in detail.

It will be noted that two sureties are required in a sum of £500 each, that rates of wages current in the district in which the work is carried out are to be paid, and that no definition as to the extent the engineer's powers in relation to objecting to foremen or workmen in the employ of the contractor are given.

The arbitration clause, though to a certain extent limited, will in all probability be accepted by tenderers. It should be noted that in all points regarding quality of materials, the engineer's decision is final, other questions are subject to independent arbitration. We do not suggest that in this case there need be any fear of trouble arising from this cause, but we have repeatedly pointed out that in our opinion it is far more satisfactory to all parties when the arbitration clause contains no limitations.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

5,228. "Improvements in continuous current dynamos, motors and converters." J. Atkinson. March 3rd.

5,245. "Enclosed arc lamp with four carbons placed vertically and in series, also mechanism." J. Gray. March 3rd.

5,263. "A portable electric light for sanitary engineers and others, to examine drains, tubes, and pipes with." J. E. Doughty. March 3rd.

5,290. "Improved apparatus for preparing flattened metallic coils for electrical magnets, solenoids and other purposes." R. E. B. Crompton. March 3rd.

5,292. "Improvements in electric igniting devices for miners' lamps and the like." R. Feilendorf. March 3rd.

5,294. "Electric rammer for foundry and other use." D. A. Caspar. March 3rd.

5,296. "Improvements in automatic checking devices applicable to electric meters." R. Chauvin and R. Arnoux. March 3rd.

5,301. "Improved lubricant for electrical purposes." A. J. Boult. (C. Ulbrich, Germany, and G. Pommerhanz, Austria.) March 3rd.

5,308. "Improvements in submarine cables." F. Tremain. March 3rd.

5,312. "An improved instrument for measuring differences of temperature, electrical potential, electrical current, atmospheric dryness, and the like." R. Chauvin and R. Arnoux. March 3rd.

5,320. "Improvements in swivelling contacts for cables used in trolleys or collectors used in connection with electrically-propelled vehicles." E. M. Munro, R. Brecknell and H. I. Rogers. March 4th.

5,323. "Improved apparatus for automatically reversing trolley or other current-conducting poles in overhead and underground electric tramways and railways." F. E. Ward. March 4th.

5,341. "Improved electricity mains." F. J. Cooper. March 4th.

5,366. "Improvements relating to electric accumulators." J. E. G. Meran. March 4th. (Complete.)

5,374. "Improvements in dynamos, motors and the like." The Hon. C. A. Parsons. March 4th.

5,375. "Improvements in and relating to the winding of the field magnets of dynamo-electric machines and other apparatus." F. L. Muirhead and J. Parr. March 4th.

5,425. "An improved trolley pole harp for use in electric overhead traction systems." J. H. Walker. March 4th.

5,468. "Improvements in trolley-heads for electric tramcars." W. Willenbucher. March 5th. (Complete.)

5,505. "Improved system of electric lighting for trains or trams, applicable also to other purposes." H. Leitner and R. N. Lucas. Dated March 5th.

5,512. "Improvements in electric cables." G. G. M. Hardingham. (Felten and Guilleaume Carlswerk A. G. Germany). March 5th.

5,530. "Improvements in apparatus for measuring and indicating an electricity supply." C. H. Merz. March 5th. (Complete.)

5,535. "Improvements in electricity meters." K. Anderson. March 6th.

5,538. "Improvements in apparatus for the electro-deposition of metals." The Calico Printers' Association, Ltd., and W Cotsworth. March 6th.

5,560. "Improvements in and connected with electric tramcars." B. North. March 6th.

5,603. "Improvements in or connected with electric cables or conductors and casings therefor." G. E. Heyl-Dia. March 6th.

5,610. "An improved form of high frequency apparatus, commonly called a D'Arsonval coil." A. C. Cossor and W. M. Hilliar. March 6th.

5,618. "Improvements in or connected with wireless telegraphy." J. Cervera. March 7th. (Complete.)

5,647. "Improvement to safety clutches used on hoists, davits, and lamps or any haulage gear." A. E. Carter. March 7th.

5,652. "Improvements in guard wires used in connection with electric trolley wires." F. Smith. March 7th.

5,654. "Electric trolley wire finder." T. Corser. March 7th.

5,663. "Improvements in electrical fuse boxes." L. M. Waterhouse and The Simplex Steel Conduit Company, Limited. March 7th. (Complete.)

5,668. "Improvements in or applicable to pendants for incandescent electric lamps." W. R. Laidlaw and G. H. Scholes. March 7th.

5,702. "Improved brake and speed controller for electrically-operated cars." J. A. Thumling. March 7th.

5,711. "Improvements in driving devices for electrical purposes." J. F. Jacob. March 7th. (Complete.)

5,715. "Improvements relating to electrolytic cells." P. A. Guye. March 7th.

5,718. "A method of and apparatus for the formation and subsequent regeneration of mercury cathodes under unvarying conditions." P. la Cour and J. J. Rink. March 7th. (Complete.)

5,743. "An improvement in or in connection with the trolleys of electric tramways." W. E. Layland and C. W. Dawson. March 8th.

5,759. "Improvements in apparatus for electric tramcars and other cars for cleaning the rail metals, removing obstructions, preventing oscillation with concussion guard, and auxiliary brake to modify accidents." R. J. Plunkett. March 8th.

5,779. "Improved construction of controller for electric lifts, tramcars and other moving bodies." R. F. Carey and J. Richmond & Co., Limited. March 8th.

5,786. "Improvements in reverse electric current relays." British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) March 8th.

5,797. "Improvements in apparatus for wireless telegraphy." Marconi's Wireless Telegraph Company, Limited, and A. Gray. March 8th.

5,802. "An improved electrical safety fuse appliance." Siemens Bros. and Co., Limited. (Siemens & Halske A. G., Germany.) March 8th. (Complete.)

5,804. "Improvements in wireless electric selecting systems." L. H. Walter. March 8th.

5,812. "Improvements in liquid resistances or switches for electrical purposes." J. H. Woolliscroft. March 8th.

5,818. "An improved arrangement for the prevention of pulsations and sudden alterations in periodicity in alternating current generating plants." W. E. Evans. (Allgemeine Elektricitats Gesellschaft, Germany). March 8th. (Complete.)

5,819. "Improvements in electric and other power hoists and cranes." J. Holt, C. Holt, and J. W. Powell. March 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

3,545. "Improvements in and relating to the insulation of electric conductors." N. Frank. Dated February 22nd, 1900. Conductors are insulated with waste silk fibre in a spun or other condition. The silk fibre is separated from a mixture of silk and vegetable fibres by a carbonising process in which the vegetable fibre is destroyed by hydrochloric acid, and is afterwards removed. 2 claims.

3,561. "Improvements in electric ignition for internal combustion motors." W. J. Crossley and J. Atkinson. Dated February 23rd, 1900. The sparking terminals in a chamber communicating with the cylinder are suddenly separated to produce a spark by exciting an electro-magnet, which, by attracting a weight, causes it to impinge against a washer on the stem. The weight may be attached to the rod, and may be attracted by a core to the electro-magnet. Two igniters may be fixed to a cylinder, and either of their ports may be closed by a screw-down valve. 5 claims.

3,586. "An improved device for finding the electric poles." F. de Mare. Dated February 23rd, 1900. Indicating direction of currents by change of colour of a liquid at electrodes. A tube of ebonite or other insulating material, has a longitudinal partition extending nearly to its ends, and near one end has lateral extensions and inspection openings closed with glass. The ends and lateral extensions are closed by plugs, two of which carry electrodes. The tube is partly filled with the liquid, and may be used with either end downward, to obtain different lengths of liquid resistance between the electrodes. 4 claims.

3,600. "Improvements in switches or cut-outs for overhead electric wires." A. Ellis and W. T. Smith. Dated February 23rd, 1900. Relates to means for connecting overhead conductors to earth in case of fracture. 3 claims.